

Operation Manual

Plastic Identification and Sorting Plant

Model: ***sIRoSort***

Rev: 104-04

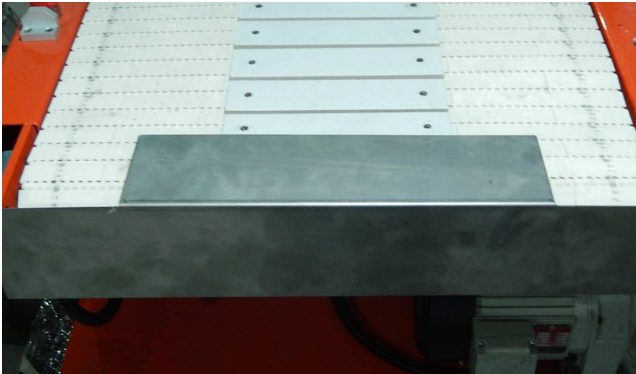
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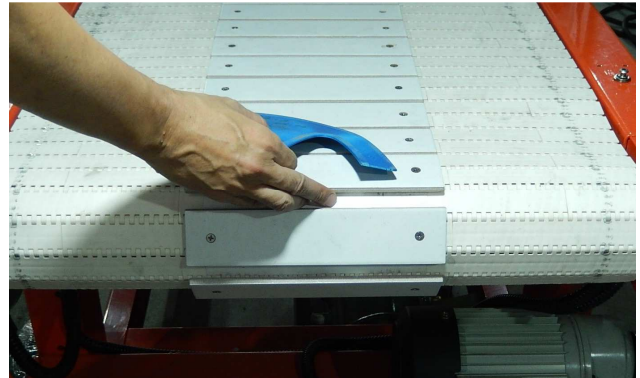
Operation manual of sIRoSort

Safety:

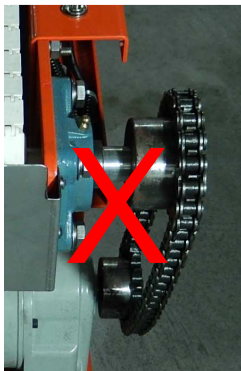
1. On the identification conveyor and drop conveyor



Unless for maintenance, always leave the cover of ceramic plates mounted at the inlet.

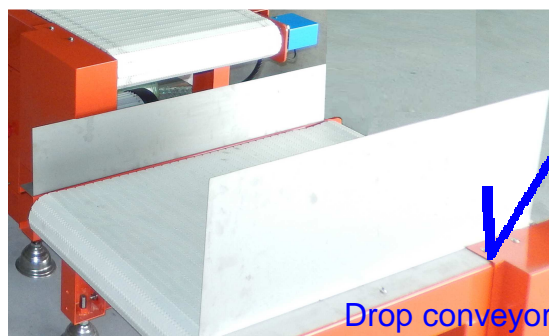
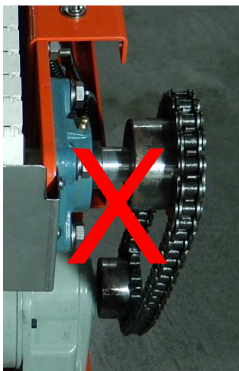


In case of cover of ceramic plate is removed, the ceramic plate at the turning point at inlet and outlet may hurt operator's finger when contacted the turning points of the conveyor.



Unless for maintenance, always leave the cover of the sprocket drive box mounted

2. On the drop parts conveyor

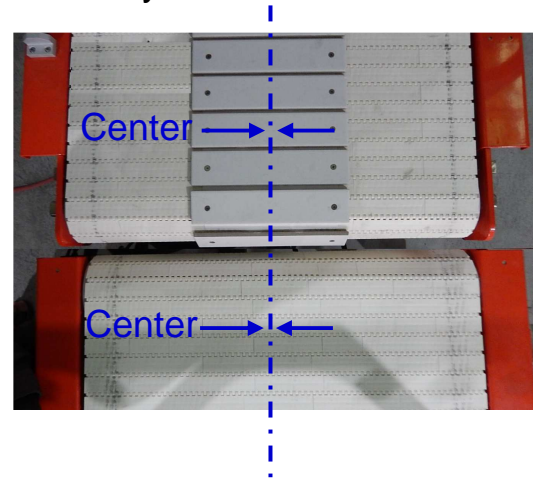


Unless for maintenance, always leave the cover of the sprocket drive box mounted

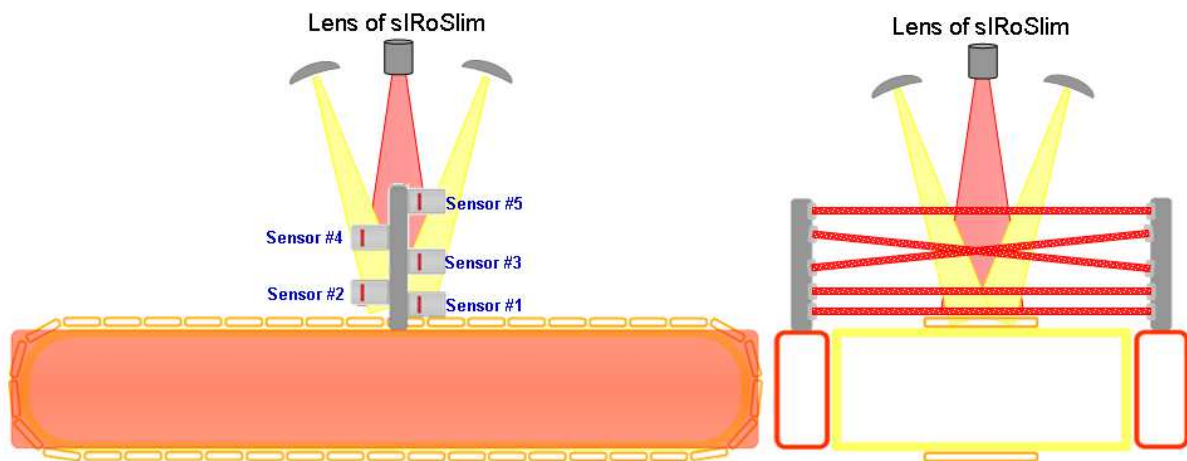
Set up of conveyors:

1. To align the sorting conveyor to the identification conveyor

In order to get the plastic parts from identification conveyor fall onto the position of sorting conveyor closest to the ejector and pusher, it is advisable to align the centerline of the identification conveyor to the centerline of the sorting conveyor.

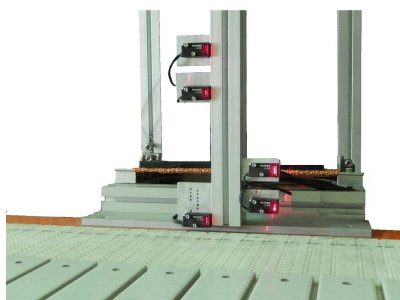


2. Laser sensors on identification belt conveyor



To detect the presence of the plastic parts on the conveyor, right under the optical identification unit, five(5) laser sensors have been installed.

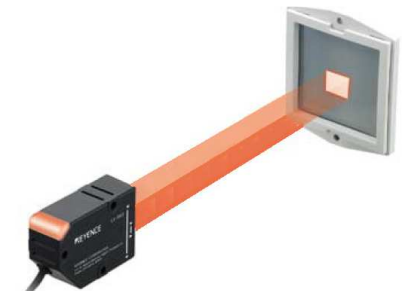
Sensor #1, #2, and #5 are set horizontally, sensor #3 is set inclined downward, and sensor #4 is set inclined upward opposite to sensor #3, formed a missing-proofing web to effectively capture the odd-shaped parts passed through.



The emitter



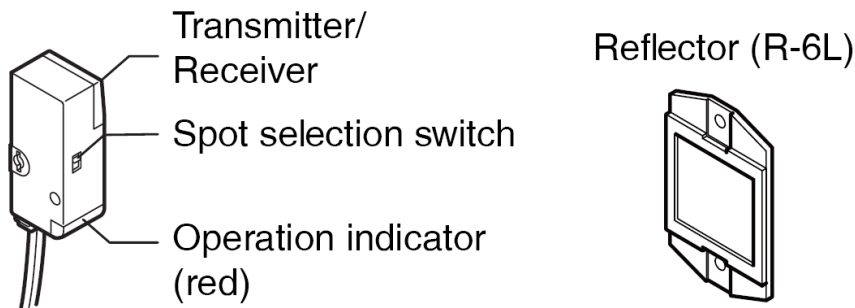
The reflector



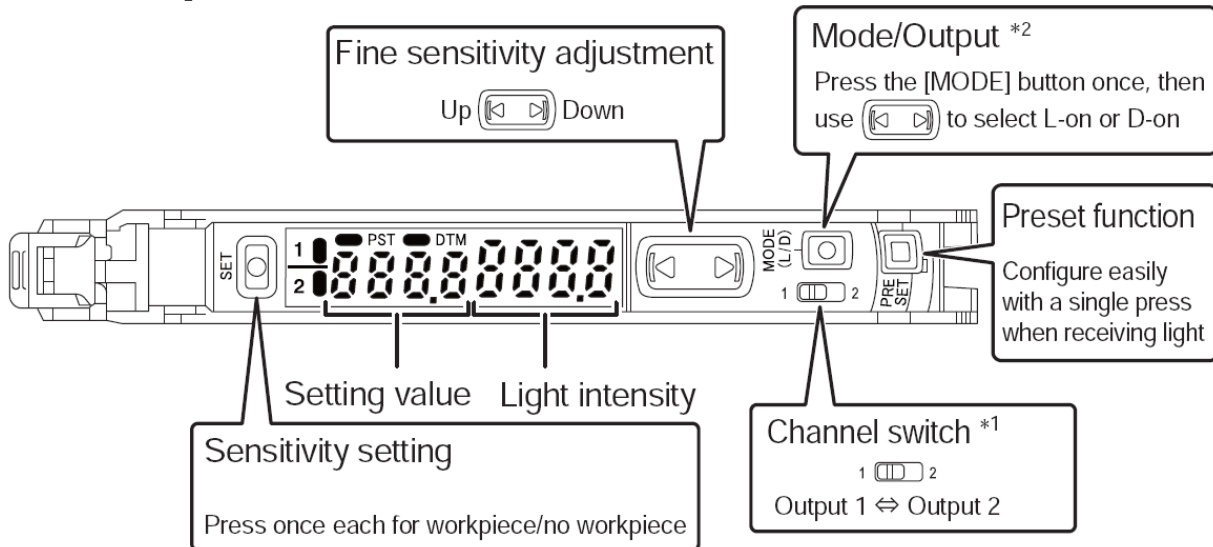
The laser beam must be emitted in the center area of the reflector

Note: Neither the emitter nor the reflector of laser sensor can be wetted, or the mal-function will occur

The Transmitter, Receiver, and Reflector

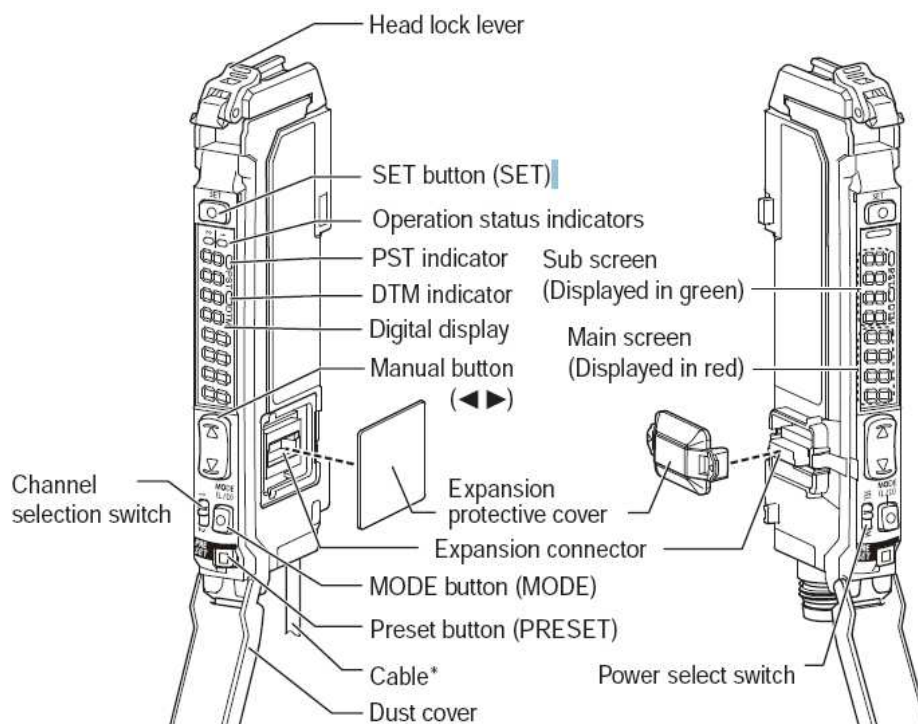


The Amplifier



*1 This is a power select switch on M8 connector types or monitor output types. Not available for 0-line types.

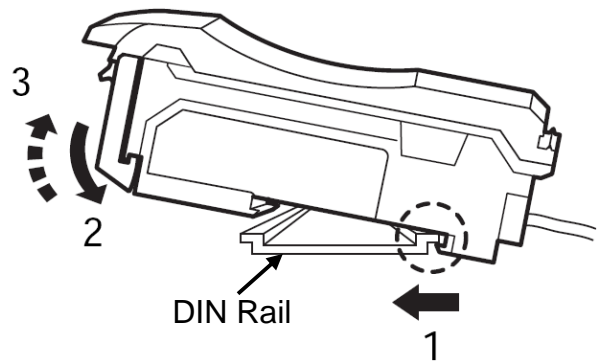
*2 Press and hold the [MODE] button to make advanced setting changes.



Mounting the Amplifier Unit

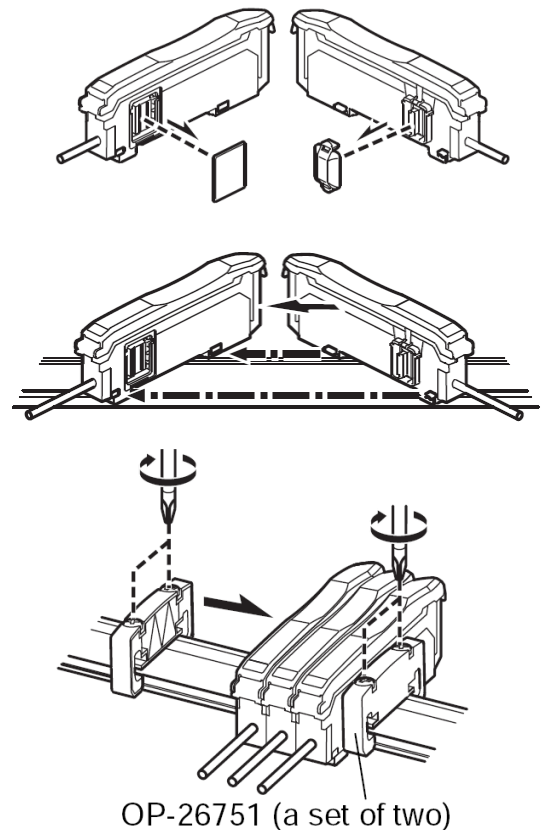
When Mounting on a DIN Rail

1. Align the claw at the bottom of the main body with the DIN rail, as shown on the right. While pushing the main body in the direction of the arrow 1, push down in the direction of arrow 2.
2. To dismount the sensor, raise the main body in the direction of the arrow 3 while pushing the main body in the direction of arrow 1.



Connecting Multiple Amplifiers

1. Remove the protection covers from the main unit and expansion unit(s).
2. Install the amplifiers on the DIN rail, one at a time.
3. Slide the main unit and expansion unit(s) together. Engage the two claws of the expansion unit with the recesses on the main unit side until you hear/feel a click.
4. Attach the end units (option: OP-26751) to the DIN rail in the same way as step (2).
5. Secure the amplifiers between the end units. Tighten the screws at the top (two screws per unit) with a Phillips screwdriver to fix the end units.



Calibration Method

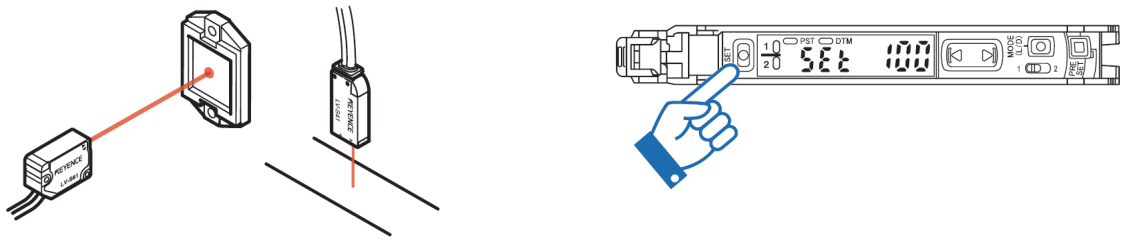
■ To Detect Small Differences

● Two-point Calibration

Two-point calibration is the basic method of calibration. Press the [SET] button once without the work piece, and then press it once again with the work piece.

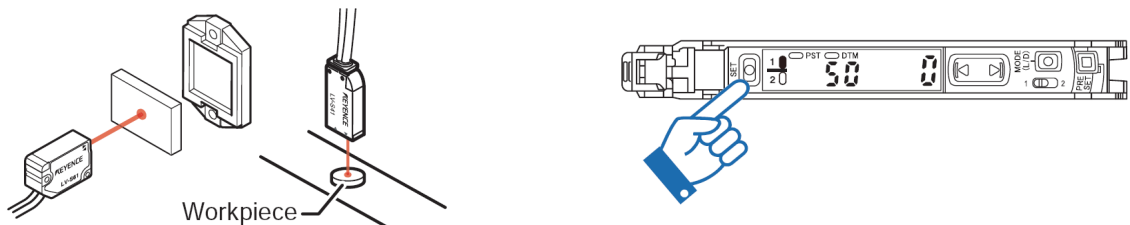
1. Press the [SET] button with no work piece.

[SET] will be displayed on the sub-menu (green display).



2. Press the [SET] button with a work piece.

When complete, the values will be set and the submenu (green display) will flash. The set point will be calibrated to the mid-point between the light intensity when there is no work-piece, and the light intensity when there is a work piece.



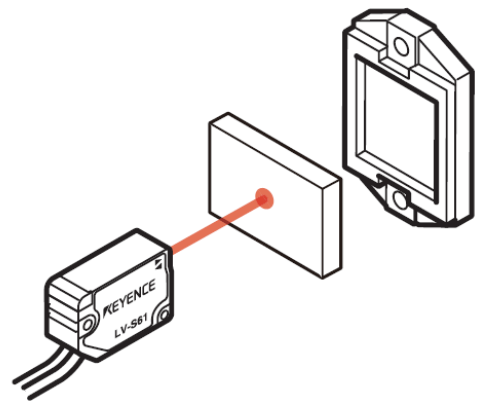
If "----" flashes for two seconds on the main screen, the light intensity is too small between conditions when the work piece is absent and when it is present. These values will be set, but there is the possibility that detection may become unstable.

Other Calibration Methods

■ Increased Resistance to Dust and Dirt

● Maximum Sensitivity Calibration

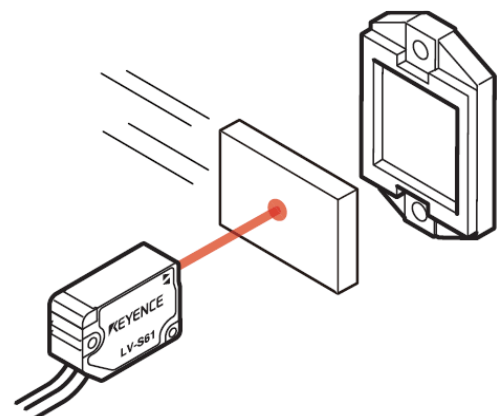
In the state shown as sketch on right side, press and hold the [SET] button for three seconds or more. Stop pushing when "SET" flashes. The sensitivity is set slightly higher than the received light intensity.



■ Calibrate with a Moving Workpiece

● Full Auto Calibration

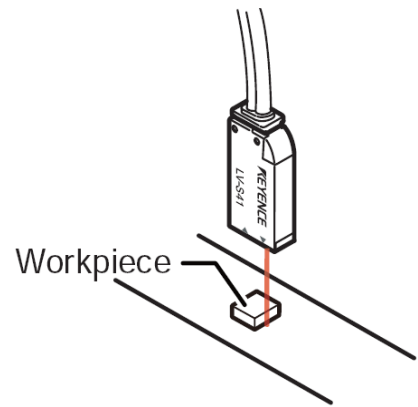
Press and hold the [SET] button with no work piece in place. While "SET" is flashing, pass a work piece through. (Continue pressing the [SET] button while the work piece passes through.)



■ Work piece Positioning

● Positioning Calibration

Press the [SET] button with no work piece.
Place the work piece in the location you wish to position it. Press and hold the [SET] button for at least 3 seconds. Release the button when "SEt" flashes.



■ Simple Setup Functions

Simple Display: Adjusting the Current Value to 100.0 With the LV-N10 Series, the current value can be set to 100.0 through simple key operations. Using a constant current value is useful for predictive maintenance allowing you to find the sensor amplifier for which the received light intensity has decreased.

- Neither preset function below can be used in combination with the zero shift function. Always disable the zero shift function before using the preset function.

! Point

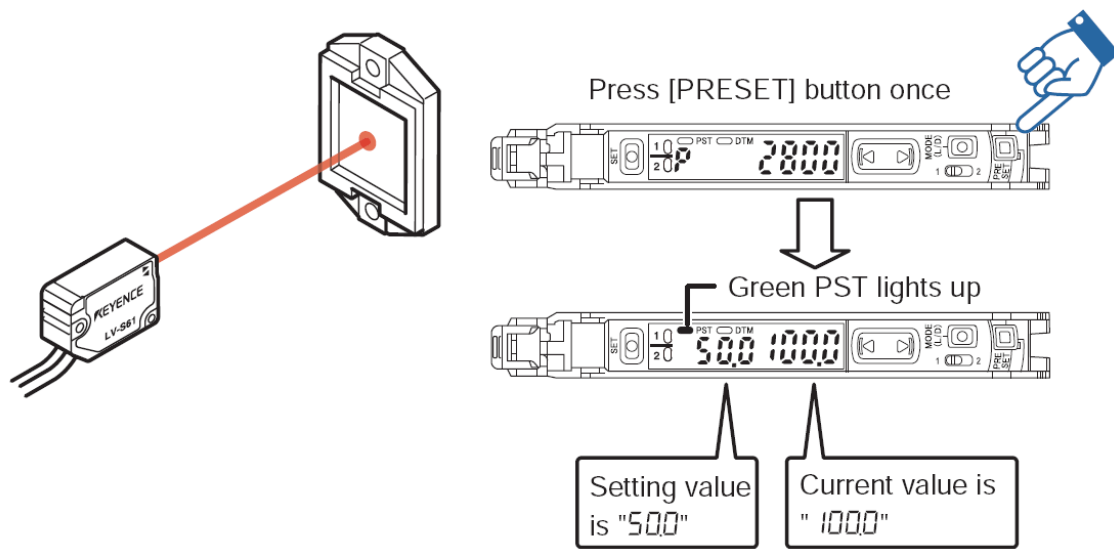
- The preset function is not suitable for detecting work pieces Which have a small received light intensity, such as transparent work pieces, etc.
- Refer to the "LV-N10 Series User's Manual" for the operation Method of analog output in respect to the preset display.

Reference

Press and hold the [PRESET] button to disable each preset function.

● Preset Function

This function calibrates the current value to "1000" when the [PRESET] button is pressed in the light-ON state.



Reference


- This function is especially useful when performing simple detection(sensor beam completely interrupted by a non-transparent object)using the thru-beam model / retro-reflective model sensor heads. When using multiple Neo Series units, the display can be easily standardized with this function.

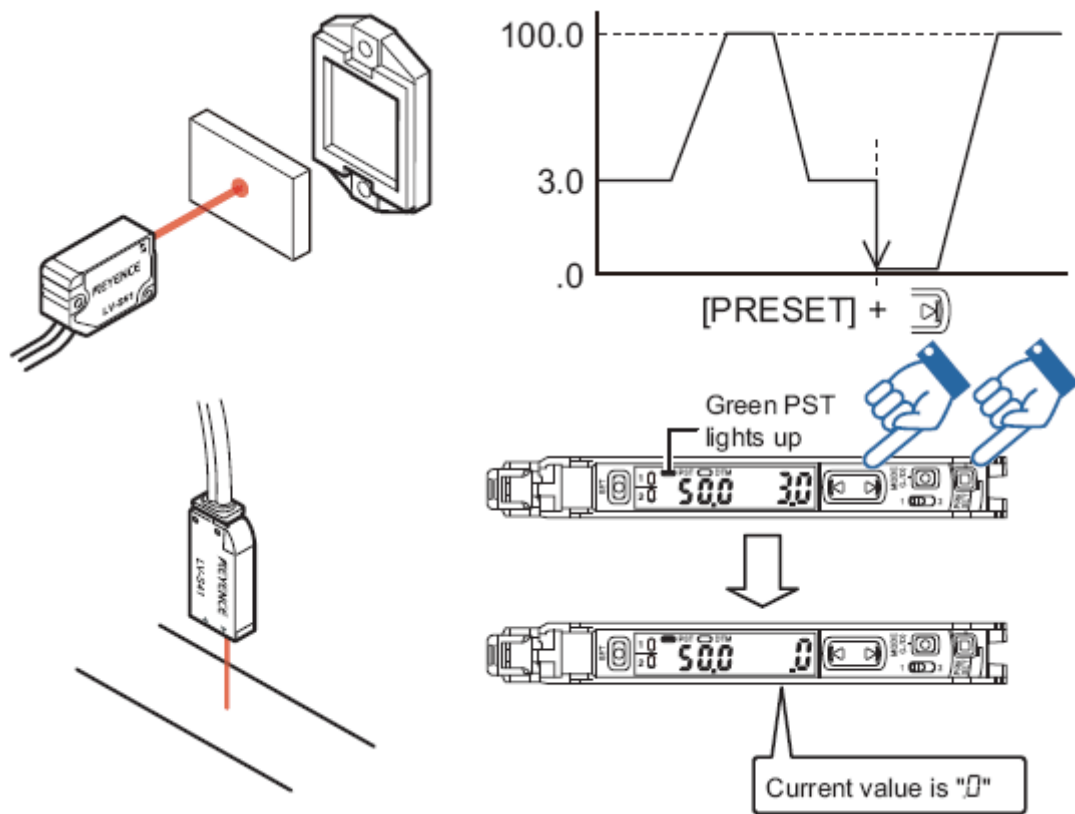
● Target-Preset Function

This function calibrates the current value to ".0". After the preset function has been executed to display "1000", execute this function to display ".0". Two random points can be calibrated to "1000" and ".0".

▶ Important

The target-preset function can be used in combination with the standard preset function (when use of the preset function is valid).

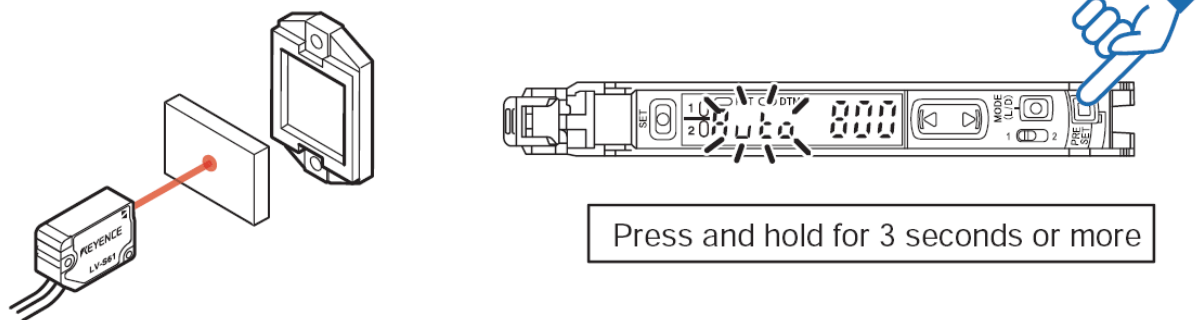
If the  button and [PRESET] button are pressed simultaneously, the current value is set to ".0" at that point. The value set to "1000" with the [PRESET] function does not change.



●Maximum Sensitivity Preset Function

This function sets conditions that will serve as reference to ".0" and adjusts conditions with slightly higher light intensity to "1000". This is useful when you would like to perform detection using the background as a reference with reflective models. Under the following conditions, press and hold the [PRESET] button for 3 seconds or more. Then release your finger when "Auto" flashes.

Thru-Beam Model / Retro-Reflective Model : with workpiece



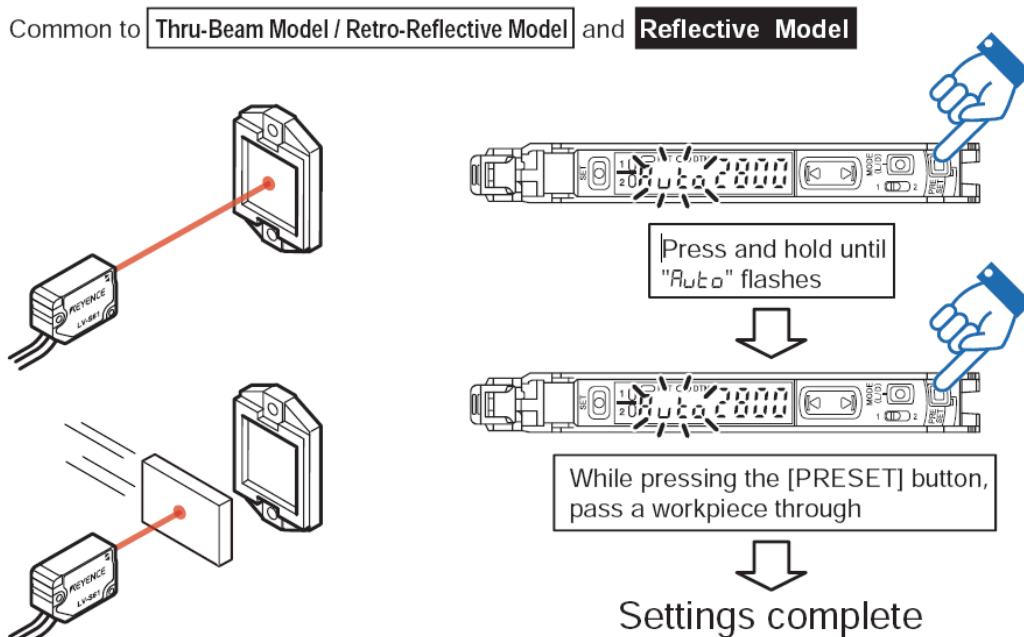
- The maximum value for the light intensity while the [PRESET] button is being pressed is set to ".0", and light-intensity that is slightly higher than the maximum value at that time will be adjusted "1000".
- The setting value is "500"
- The green PST indicator will light up.

! Point

- Cannot be executed when the Preset function is already being used (when the PST indicator is flashing). Press and hold the [PRESET] button to disable the Preset function before executing this function.
- The maximum sensitivity preset function cannot be used when the LV-NH100, NH110 or NH300 is connected, but by holding down the [PRESET] button in the light ON state, the amount of light blocked at light intensity 0 and light block 1000 is displayed.

● Full Auto Preset Function

This function automatically differentiates between two conditions (presence/absence of work piece) and adjusts the current values to " 1000 " and " 0 ". This is effective for cases when the work piece is moving at high-speed. Press and hold the [PRESET] button with no work piece in place. While "Auto" is flashing, pass a work piece through. (Continue pressing the [PRESET] button while the work piece passes through.)



- Near-maximum values while the [PRESET] button is being pressed and held are adjusted to " 1000 " and near-minimum values are adjusted to " 0 ".
- The setting value is changed to " 500 ".
- The green PST indicator will light up.

! Point

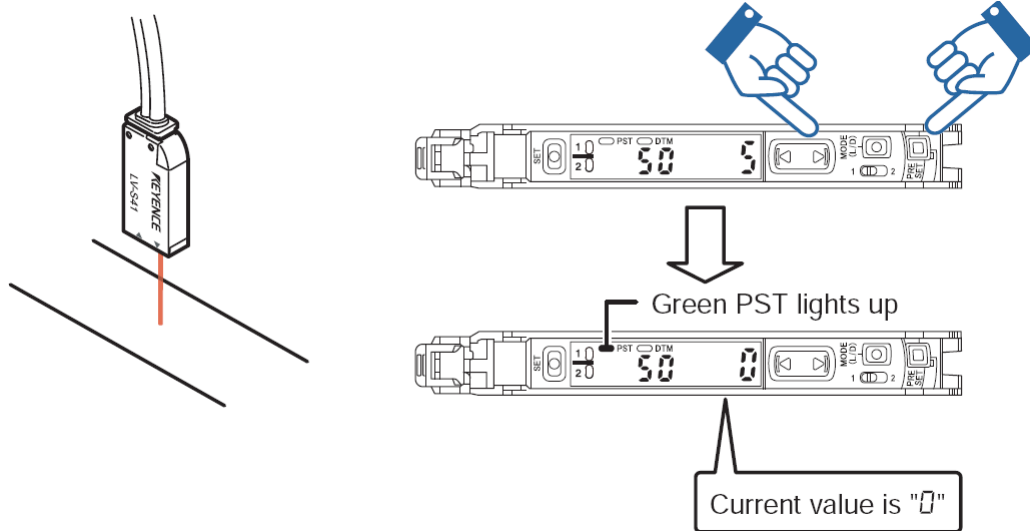
Cannot be executed when the Preset function is already being used (when the PST indicator is flashing). Press and hold the [PRESET] button to disable the Preset function before executing this function.

■ Set Current Value to "0"

● Zero Shift Function

This function is primarily used with reflective models.

Press the [PRESET] button and [>] button at the same time.



- The current value becomes ".0".
- The Green PST lights up.

! Point

The zero shift function cannot be used in combination with either preset function. To use the zero shift function, you must first disable the preset function.

● Disable the Zero Shift Function

Press and hold the [PRESET] button to disable the zero shift function.

Reference


- The light intensity may not be set to ".0" when the reflective model sensor head is first installed. In this case, using the zero shift function to set the state with no target present to ".0" will make it easier to see the difference in light intensities.

Output Switch

Either light-ON (L-on) mode or dark-ON (D-on) mode can be selected.

1. While the current value is displayed, press the [MODE] button once.

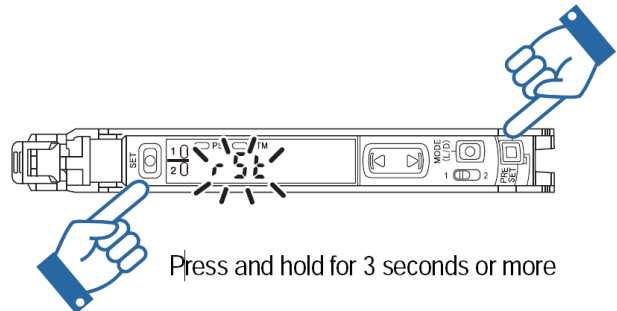




2. Use  to switch the output (L-on/D-on), then press the [MODE] button again. The output change completes, and the display returns to the current value.

Initializing the Settings

■ Initialization Method

1. Press and hold the [SET] and [PRESET] buttons simultaneously for more than three seconds.



2. Use the  to select "r5t", then press the [MODE] button.
3. Use the  to select "in t", then press the [MODE] button.
After initialization is complete, the display returns to the current value.



● Initial Settings

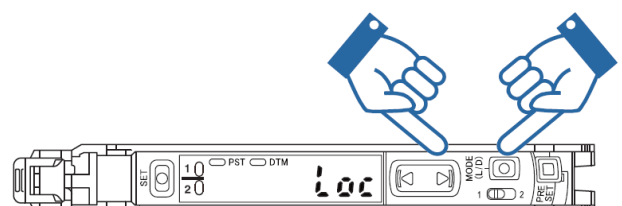
Setting	Initial value
Power mode	TURBO
Detection mode	Std (Normal)
Setting value	50
Output switch	L-on

Key Lock

The key lock function disables button operation to prevent unauthorized use.



■ Activating Key Lock

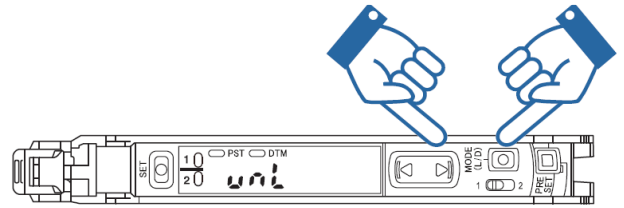
1. Press and hold the [MODE] button and  (or ) simultaneously for three seconds or more.



2. The screen displays "LOC", disabling key operation.

■Deactivating Key Lock

1. Press and hold the [MODE] button and  (or ) simultaneously for three seconds or more.
2. The screen displays "LOC", enabling key operation.

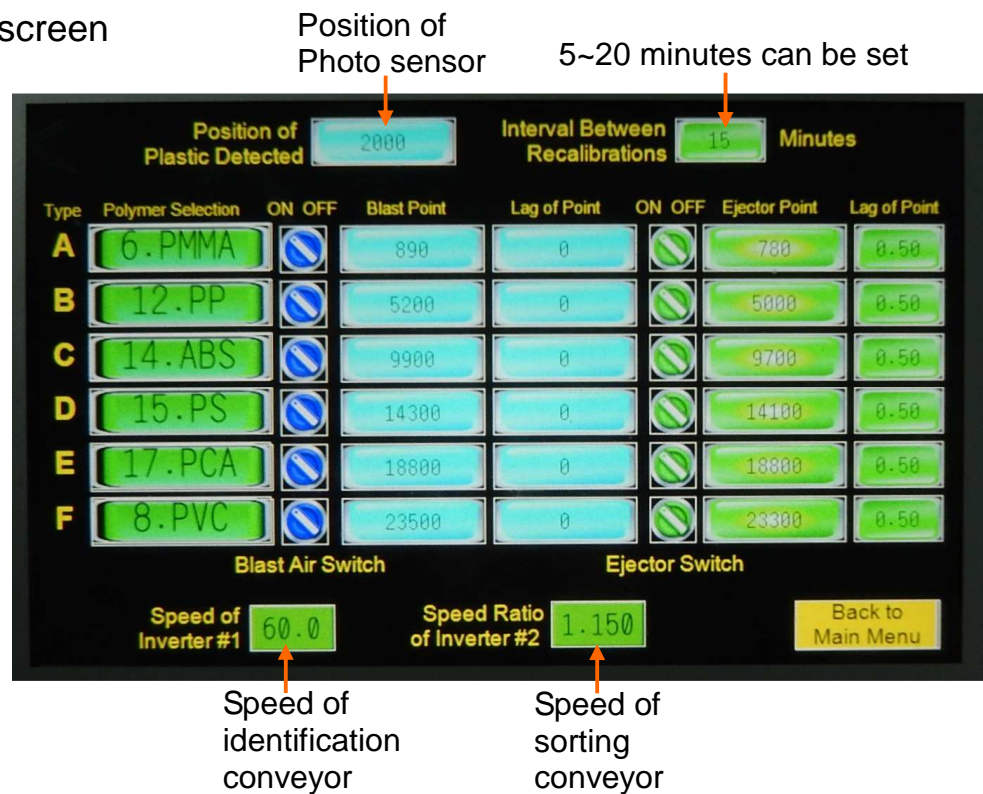


Error Displays and Corrective Actions

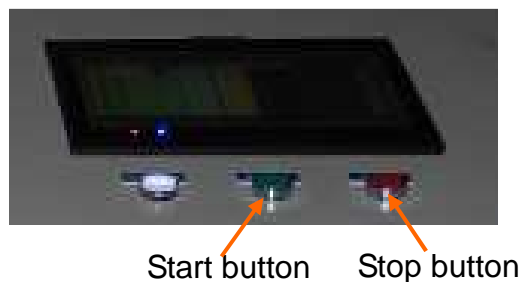
Error display	Cause	Solution
ErC	Overcurrent in the control output.	<ul style="list-style-type: none"> • Check the load and return the current within the rated range. • Check that the output wire is not contacting any other wire or frame.
ErH	Sensor head cable is broken or is not connected.	<ul style="list-style-type: none"> • Check that the sensor head is connected. • Check sensor head cable for damage. • Check the sensor head cable connector for damage or loose connections. <p>After checking, turn the power OFF and ON.</p>
ErE	Internal data write / load failed.	Turn the power OFF and ON. If the data is not recovered, initialize the settings.
Loc	Key lock function is enabled, or if using M8 connector types or monitor output types, the power mode was fixed to MEGA mode using the selector switch.	<ul style="list-style-type: none"> • Release the key lock. • Check that the sensor amplifier selector switch is set to MEGA mode.
The DTM indicator flashes.	Correction error in DATUM1 or DATUM 2 mode.	See "LV-N10 Series User's Manual" for details.

Operation of control console

1. Outline of touch screen

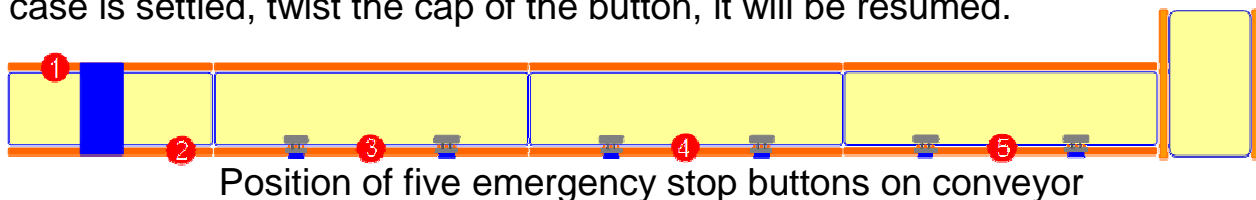


2. Start and Stop button



3. Emergency stop buttons

There are total five(5) emergency stop buttons distributed on the identification and sorting conveyors. In case of emergency, press down anyone of it, conveyor will be stopped. Upon emergency case is settled, twist the cap of the button, it will be resumed.

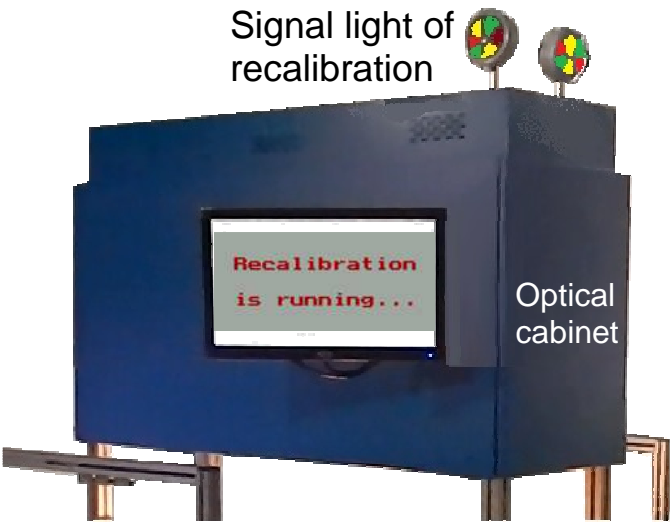


2. Recalibration

In order to maintain the minimal accurate identification result, it is advisable to set an interval of recalibration.

After pressing the green "Start" button, the operation runs till the interval set is up, the light come "ON and Flash", the recalibration of identification unit takes place, and the display of monitor screen change, however, conveyors will not stop.

When recalibration is running, operator should stop feeding the plastic parts onto the identification conveyor; the recalibration will be complete in 15~20 seconds, signal light will go “OFF”, the operator could continue the operation.



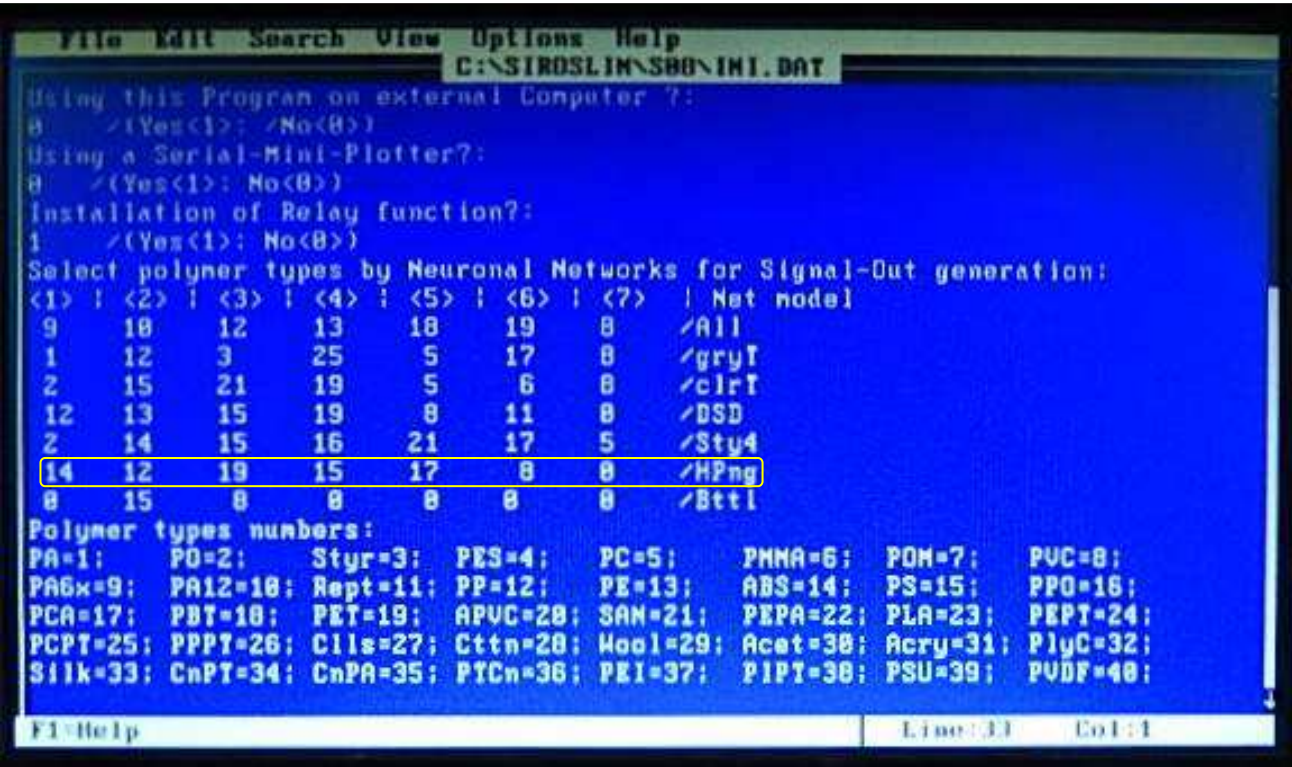
3. Selection of polymer type corresponding to output bins

There are two settings need to be carried out – the IoSys identification unit, and the control console.

3-1. To set the polymer type on IoSys Identification unit, keep pressing the “Esc” key of the keyboard on the optical cabinet until DOS prompt screen comes out.



Key in the command “edit ini.dat”, then “Enter”, the display below on the screen is seen.



Identification mode is selected dependent on what form of plastic parts will be processed. For the complex of mixed plastic parts include the industry waste and/or household plastics, “HPng” mode is recommended.

Here is an example of setting –

Bin A	Bin B	Bin C	Bin D	Bin E
<1>	<2>	<3>	<4>	<5>
14	12	19	15	17
ABS	PP	PET	PS	PCA

Move the cursor to the right position of the screen to get the setting done, upon selection of polymer type is finished, hold the keys “Alt” + “F”, then “X”, and “Y”(Yes), setting of Identification unit is complete.

3-2. To set the polymer type on control console

By pressing the icon “Parameter Setting” on the bottom of the touch screen,



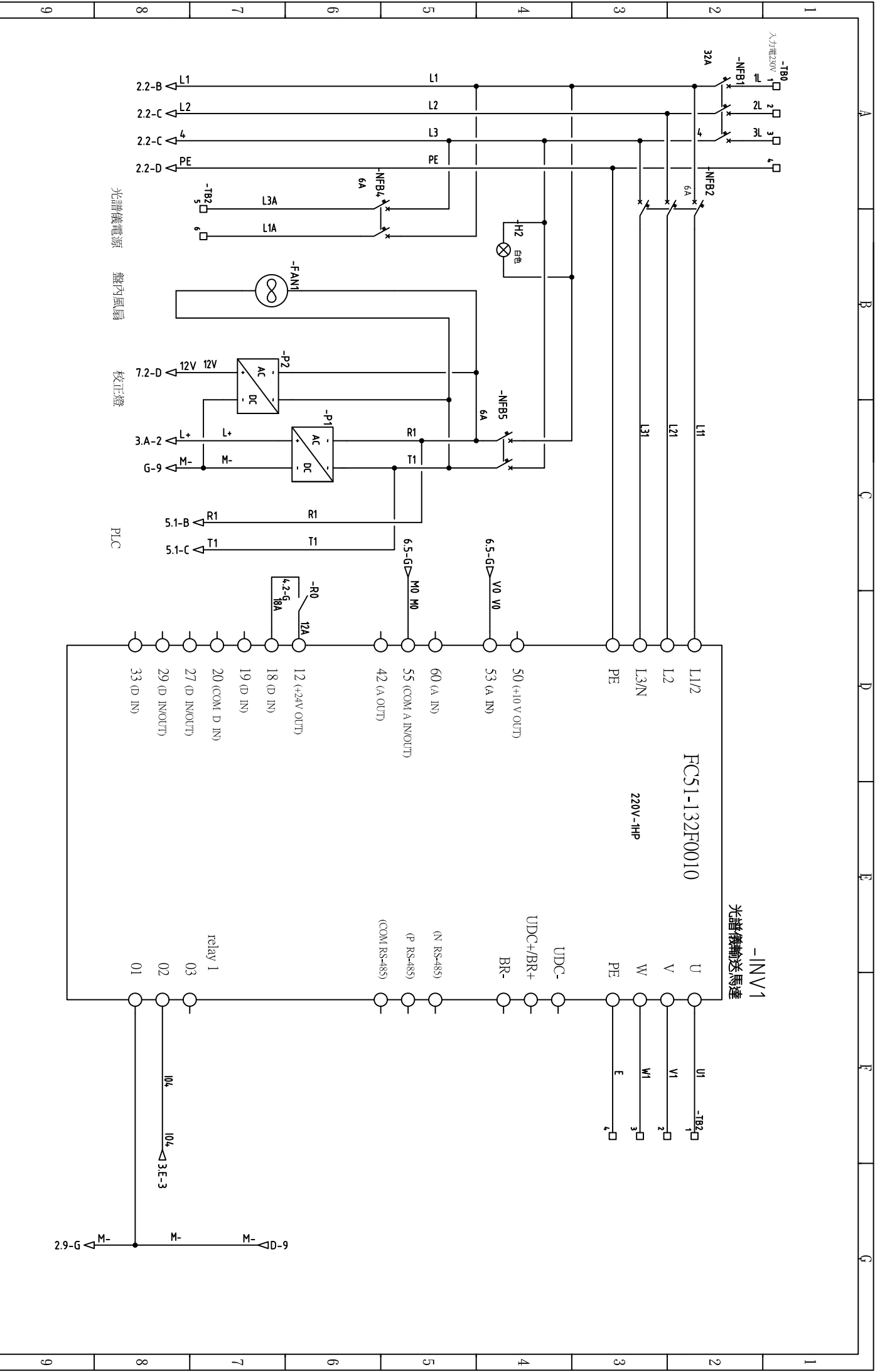
D

screen will change to the display below -



The sequence of polymer type displayed in the blocks from “A” though “F” must be identical to the setting of identification unit. Pressing the block of bin “A”, the library of polymer type comes out, press the one selected, the display is changed to the selected.

1.PA	10.PA12	19.PET
2.PO	11.REPT	20.APVC
3.STYR	12.PP	21.SAN
4.PES	13.PE	22.PEPA
5.PC	14.ABS	23.PLA
6.PMMA	15.PS	24.PEPT
7.POM	16.PPO	25.PCPT
8.PVC	17.PCA	26.PPPT
9.PA6X	18.PBT	39.PSU



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			CUSTOMER	REV
			PROJECT	1 / 10

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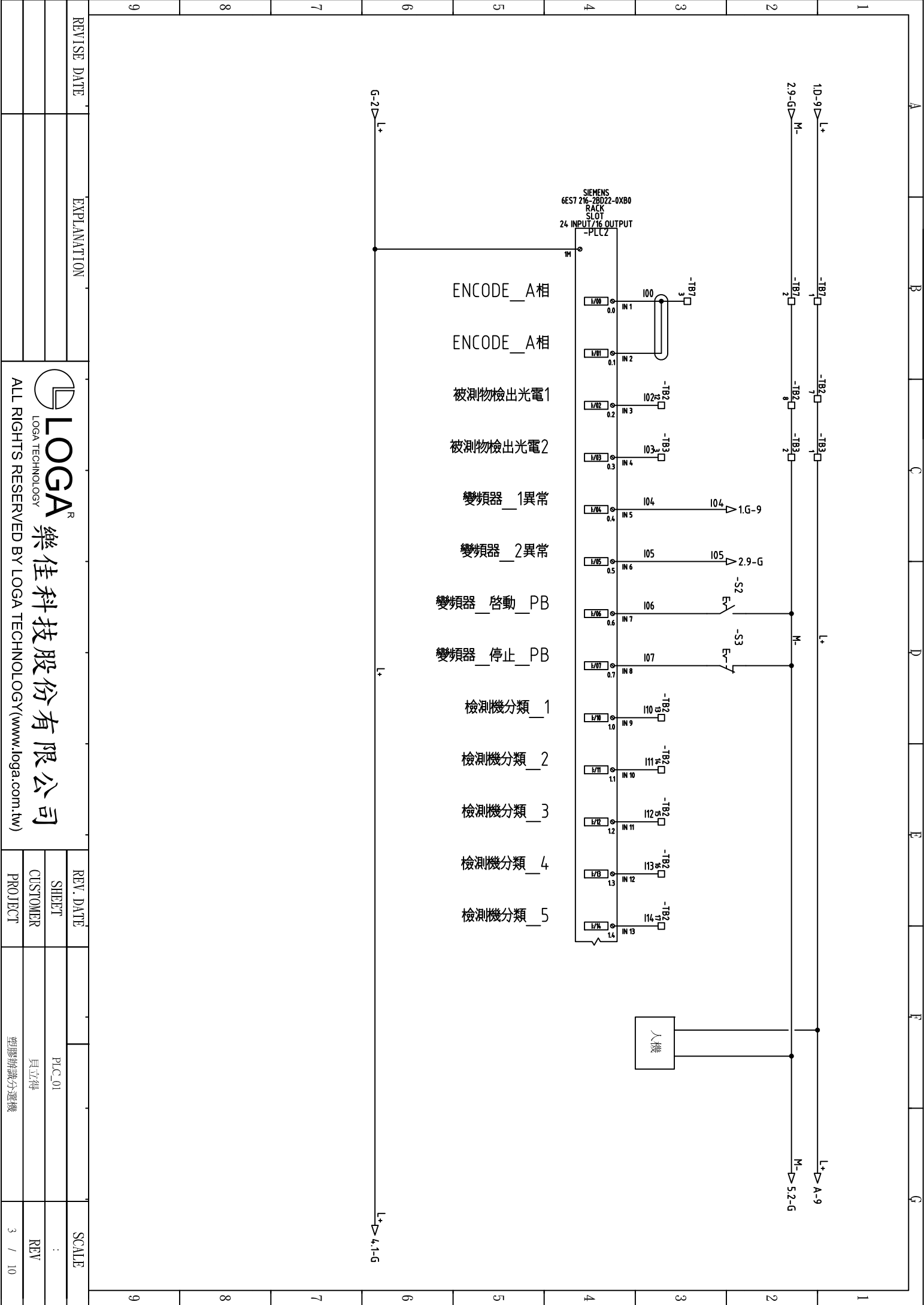
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總路圖_01

貝立得

塑膠辨識力選機

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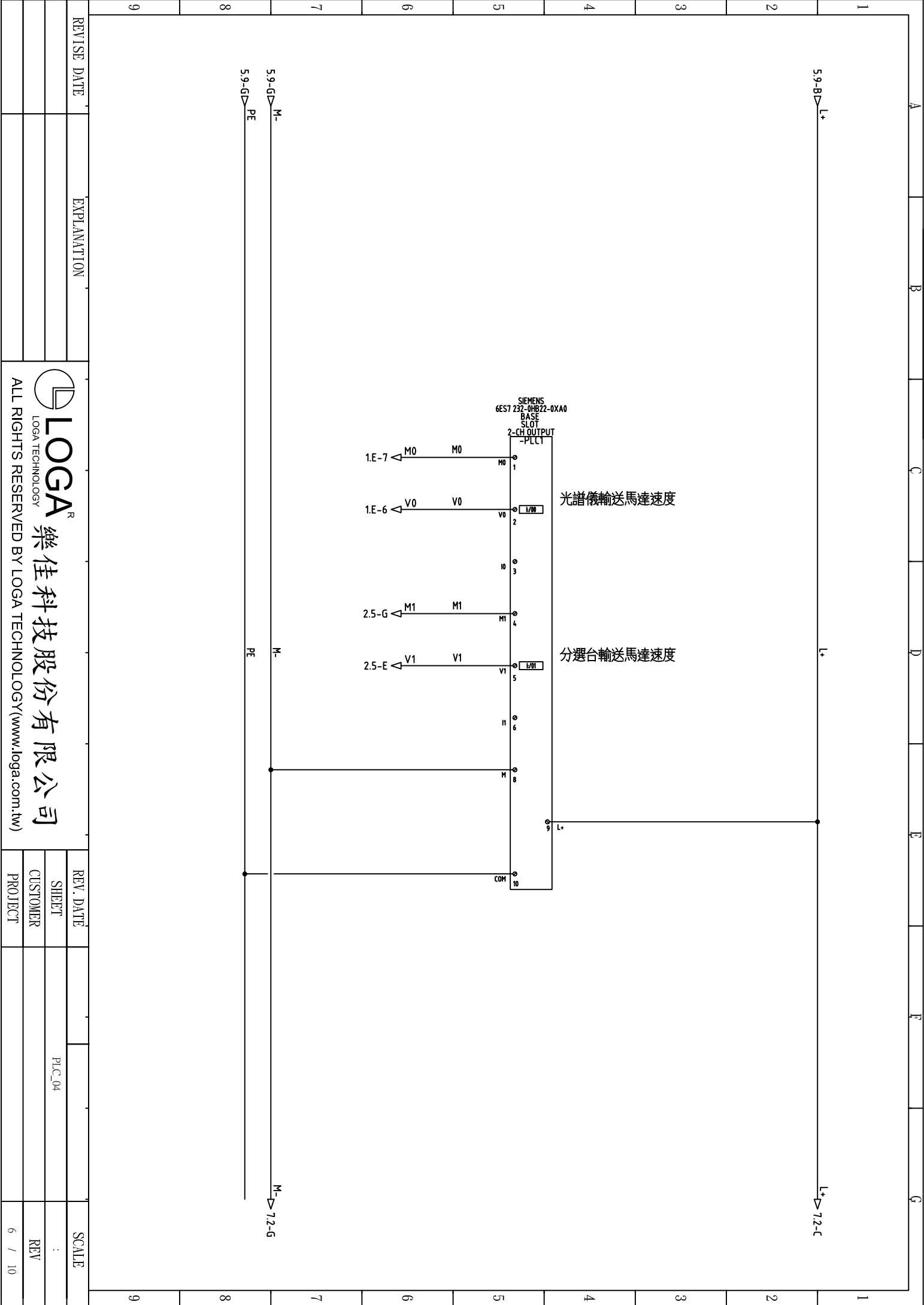
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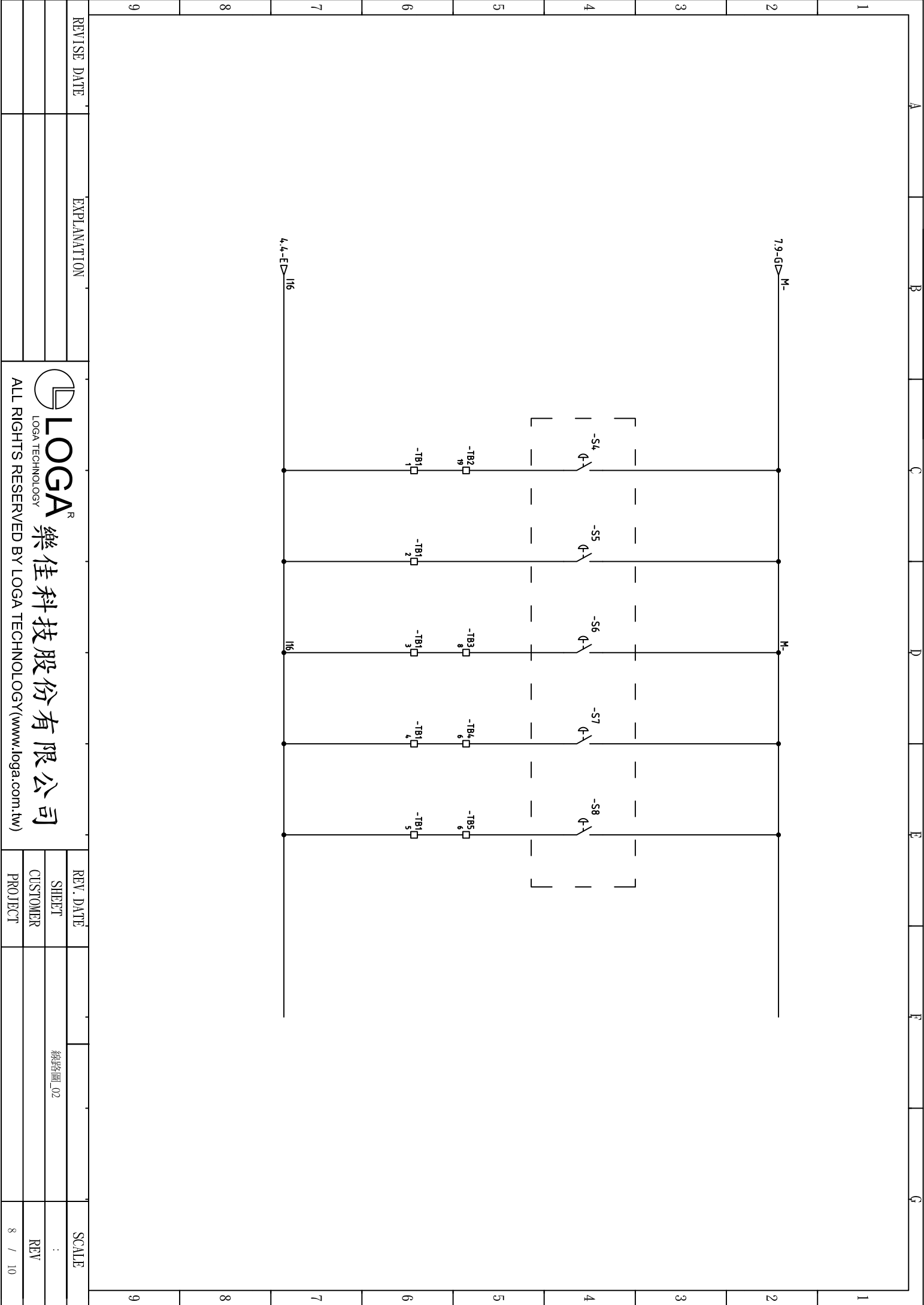
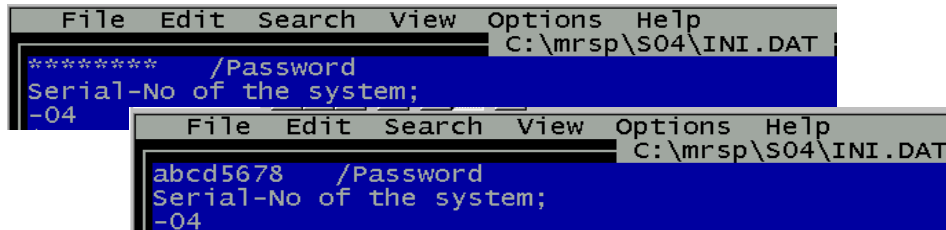


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1 Enter new Password

The system is secured with a password which activates the sIRoSlim-program (miro.exe). In case the message: **Program deactivated!**... is displayed, please contact office@iosys-seidel.de to obtain the actual password for the device.



```
File Edit Search View Options Help
C:\mrsp\S04\INI.DAT
***** /Password
Serial-No of the system;
-04

File Edit Search View Options Help
C:\mrsp\S04\INI.DAT
abcd5678 /Password
Serial-No of the system;
-04
```

To edit once the new password please proceed as following:

1. Connect an external keyboard (PS/2) and a VGA screen to the system.
2. Edit on the DOS-prompt level of the given sub-directory the command line *edit ini.dat*
3. Replace the 8 stars (*) in the first line of the *ini.dat* with the new password (8 small characters!).
4. Save the ini.dat file (ALT+F(ile), ALT+S(ave)) and close the Text-editor (ALT+X(exit)).
5. Edit on the DOS-prompt level miro.exe to start the program.



2 Time and Date Setting

To enter a new Time and/or Date for example for correct Mini-Plotter printouts please do as follows:

1. Connect an external keyboard to the system.
2. Enter on the DOS-prompt level of the given sub-directory the command *time* or *date*, resp..
3. Edit new date or time values and confirm/quit with **<ENTER>**.

3 Data Exchange using USB-Stick

For data exchange with other computers and software updates an USB stick can be connected to the USB port of the system. Before booting up¹ the system the USB-Stick must inserted correctly into the USB slot. Access to the USB-stick can be done by the means of an external keyboard and by editing **<d:>** usually.



Sometimes there is no access to the USB-Stick at first time and the following error message² is shown: **Unzulässiger Datenträgertyp beim Lesen von Laufwerk D:**
Quit the error message by editing **<w>** like (W)iederholen to repeat the access.

4 The sIRoSlim-program

4.1 Conventions in this Manual

The device is designed in such a way that it can be operated from the touchscreen and/or from an external keyboard. In general a keyboard permits the menu-guided software to be handled more easily.

The following paragraph gives the writing conventions used in these operating instructions:

Operations to be carried out via touchscreen (optional feature) are given with the legend on the respective touch field and the word **<Icon>**. Those to be carried out with the external keyboard with the legend of the keyboard key and the word **<Key>**. Usually small characters should be entered. A touch field on the display only has to be touched briefly. If a number of keys or, as the case may be, touch fields have to be pressed simultaneously, then this is indicated with a plus sign (+) between the individual key or touch field legends, e.g. **<SHIFT>+<F1>**.

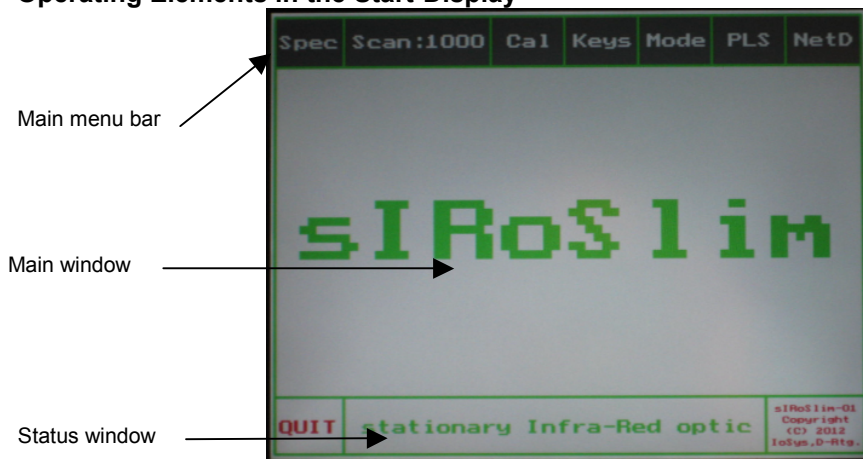
In general only small characters of the keyboard are to be used!

Pressing a key or touching an icon activates or deactivates a mode or function. In general a repeated pressing the same key or touching the same icon again deactivates/activates the operation, respectively.

¹ The USB stick will be recognized by the MS-DOS system at time of booting only ! When the USB stick is disconnected while system operation and connected again then it will not recognize the USB stick again. The unit must be restarted again.

² German based MS-DOS is used.

4.2 Operating Elements in the Start-Display



Icon	Key	Function
SPEC	F1	Switches to SPC mode to view the NIR-Spectra or the transformed Net-Data and to carry out further features (see: Operating Elements in the SPC Mode).
RUNS	F2	Decreases (<F2>) or increases (<F3>) the number of runs ³ (scan numbers) to form an average mean spectra for evaluation (see: The Bottom Menu).
CAL	F4	Starts the routine for the recalibration measurement with the ceramic plate reference (see: Recalibration of sIRoSlim)
KEYS	F5	Displays the assignment of the touch panel fields and opens further menu options for testing, setting and editing systems files for the mIRo (see: The Initialization File).
Mode	F6	Opens and closes (also with <ESC>) the function for the fastest Online identification option. No time consuming graphics for spectra displaying is needed and therefore deactivated. In the FastMode up to 7 preset polymer types (see: The Initialization File) can be counted ⁴ with corresponding external signal generation. If a value exceeds 99.999 or by selecting another identification model the counter is reset. In the FastMode the following Hotkey functions exists: <a> Standard model (All) activated <c> clearType model (clrT) activated <h> HaiPing-model (HPngT) activated <1> Modifying PA (Polyamid) results <3> Modifying Styr (Styrene) results <5> Modifying PC (Polycarbonat) results <F2> Decreasing amount of scans /runs <F3> Increasing amount of scans /runs <ESC> / <F6> Quitting FastMode
PLS	F7	Changes to the PLS model (Partial-Least-Square), where plastic identification is performed using selected Teach-In samples (see: Operating Elements in the Teach-In Menu). The activation of the PLS mode is displayed on the top and the ranking list appears now in blue letters and the icons to select the identification model are disappearing (no function). Pressing again the <PLS> icon switches back to the Neuronal network calculation and the hit list is displayed in red letters.
NetD	F8	Switches to the Result-Window (see: Operating Elements in the Result Display). In the NetD-mode (Network Data) transformed and auto scaled intensity data are displayed. Leave the Result-window by pressing any key or by touching the middle of the touch screen briefly.
QUIT	ESC	Leaves the sIRoSlim program and returns back to the DOS prompt level.

RUNS : 3000

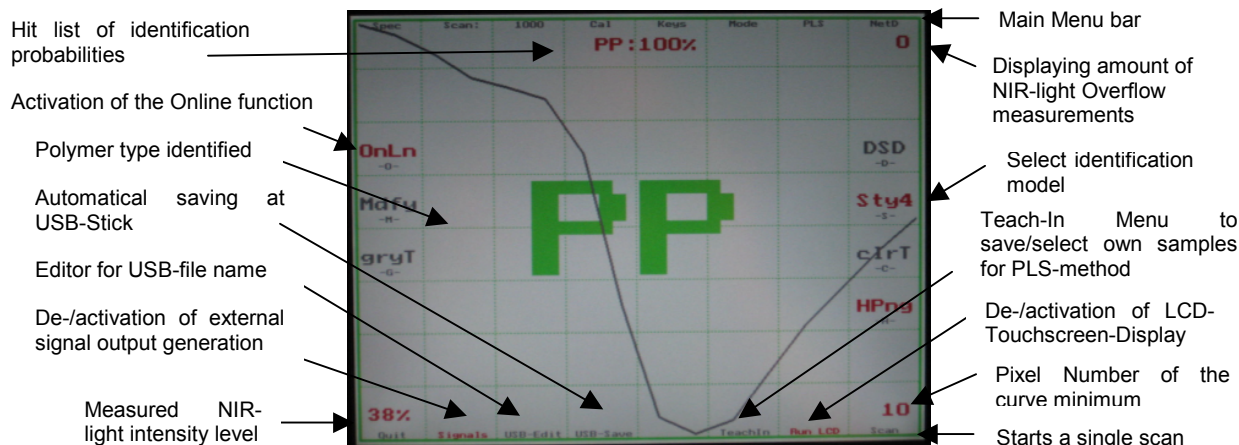


<g> grayType (gryT) activated
 <d> DSD-model activated
 <s> Sty4-model (4 Styrene types) activated
 <2> Modifying PO (Polyolefine) results
 <4> Modifying PES (Polyester) results
 <6> Modifying PVC (Polyvinylchlorid) results
 < > Reset of counter
 <ESC> / <F6> Quitting FastMode

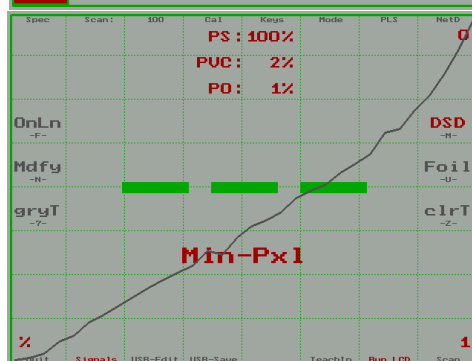
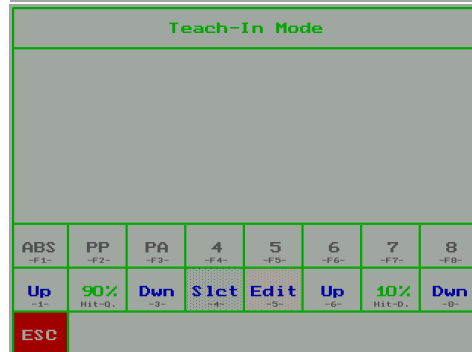
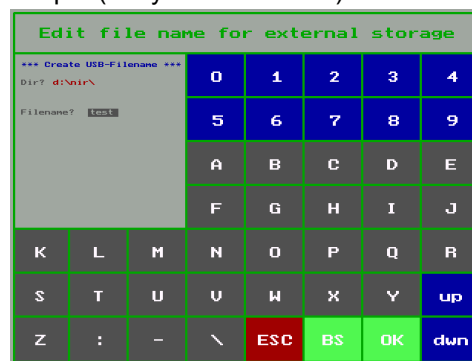
³ The higher the scan number (RUNS), the better the resulting average spectra (improved signal/noise ratio of the calculated mean), the more stable is the identification result. However, the measuring time takes longer. On the other hand, the smaller the scan number, the more noisy the resulting spectra for evaluation, the less stable is the identification result. On the other hand the measuring time takes shorter.

⁴ Due to the very fast online measurements in the FastMode the identification result is only shown and counted and the external signal by relay is only generated if the identification result is two times the same successively.

4.3 Operating Elements in the Result Display

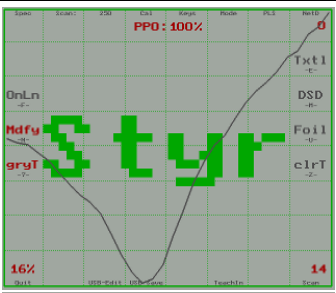
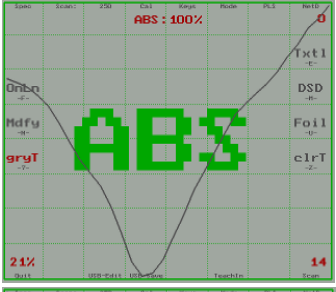
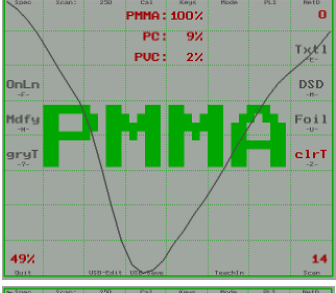
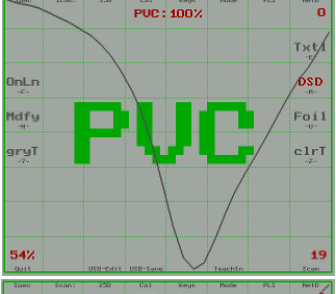
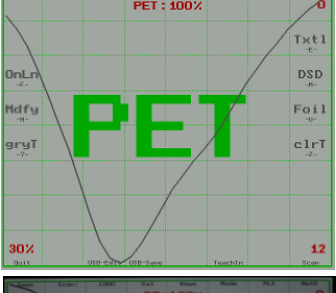
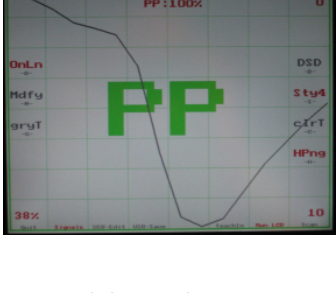


Icon	Key	Function
Signal	0	De-/activates the external signal output generation using the 7 internal relays and red LEDs. Results are only shown at the display without signal output (relay closer contact).
USB-Edit	Enter	Opens the menu to edit the main file name (max. 4 characters) for the automatic spectra saving onto an external USB-stick storage device. The USB-main series name will be displayed in red on the left top side.
USB-Save	BS	Activates the automatic USB-saving function (<Backspace>). Spectra are saved with consequent numbers up to -999 behind the main series file name ⁵ in the pre-set subdirectory path of the USB-storage device (see: The Initialization File). Repeated touch deactivates the function.
TeachIn	F10	Opens the Teach-In menu to teach-in or to select known samples (see: Operating Elements in the Teach-In Menu) for polymer identification using the PLS algorithm. (Partial-Least-Square, best fitting curve). The PLS mode is automatically activated and the hit list (ranking) are displayed in blue letters. The advantage of the PLS method is that the user can teach-in own test samples to carry out simple rapid analysis. The disadvantage is that PLS works for NIR-spectra only which obviously have big spectral differences. Pressing the <PLS> icon returns back to the Neuronal network calculation (see: Polymer Type Identification by Neuronal Networks).
Run LCD	TAB	De-/activates the integrated LCD-Touchscreen-display with the beeper-sound. While the COM-controlled LCD-touchscreen is deactivated Online results via external VGA display are shown much faster by the software. The program directly starts the Fastmode. However LCD- is activated for the sound without a measuring time delay.
Scan	↑	Starts a single scan/measurement without pressing the trigger while the Online function is not active.
OnLn	0	Start or stops the Online-mode operation whereby the NIR light source is still powered on continuously.



⁵ e.g. main series file name test-1 up to test-999.

Icon	Key	Function
------	-----	----------

Mdfy	M	Due to spectra similarity the distinction of some polymer types is sometimes uncertain and could be random-like. To modify the identification result means that the determined probability in the network model (1 st ranking in the Hit list) is altered to the main polymer group. The identification will be simplified like (ABS, PS, PPO, SAN ⇒ Styr). The Modify function can just be activated/deactivated if one of the mentioned polymer types is displayed. A temporary modification of an identification result is then signaled in red .	
gryT	G	This identification model is recommended when gray-coloured plastic parts coming from the electro- and electronic disassembling area (e.g. computer waste) are to be detected. The amount of polymer types for fine differentiation of the polycarbonate-containing sub-group within this model is extended like PCPT (PC+PET or PC+PBT). Besides the identification of filled PA, ABS, PVC and C-PVC with fillers might become better. Modified results Modified results (Mdfy) switches ABS, PS and PPO ⇒ Styr and PCA, PCPT ⇒ PC. In this gray-Type model the identification of PA , PP , Styr (ABS, PS, PPO), PC (PCA, PCPT), APVC and PVC is calibrated.	
clrT	C	Restriction of the polymer identification to few clear types which can normally occur also or only as clear, transparent plastic parts (thickness: 1 - 6 mm). This identification model is recommended, because the amount of polymer types for fine differentiation of the styrene-containing sub-group is extended within this model and other types are neglected to enhance the identification performance. Modified results (Mdfy) switches ABS, SAN (AS) and PS ⇒ Styr. Identification of PO (COP), Styr (ABS, PS, SAN), PET , PC , PMMA and PVC .	
DSD	D	This identification model is recommended when typical plastic parts coming from the household and packing area (MWS) are to be detected, because the amount of polymer types is restricted to just five polymer types which normally occur as household and packaging plastics (DSD = Duales System Deutschland, Green Dot). Modified results (Mdfy) switches PP, PE ⇒ PO. In this DSD-model the identification of PP , PE , PS , PET and PVC is calibrated only.	
./.	A	This All/Standard identification ⁶ model (no special model activated in red) is recommended when coloured, natural- or milky-like plastic parts (not gray, not black and not transparent) are to be detected. Herein the amount of polymer types for fine differentiation of the styrene-containing sub-group is reduced (only ABS and PS). However fine differentiation between PA6x (PA6 or PA66) and PA12 and PCPT, PC and PCA is possible. Modified results (Mdfy) switches PA6x, PA12 ⇒ PA and PP, PE ⇒ PO and ABS, PS ⇒ Styr and PBT, PET ⇒ PES and PCA, PCPT ⇒ PC. Identification of PA ⁷ (PA6x, PA12), PO (PP, PE), Styr (ABS, PS), PES (PBT, PET), PC (PCA, PC, PCPT), PMMA , POM and PVC .	
HPng	H	This identification model is recommended for almost all materials (except film/foils and dark coloured ones) for the conveyor belt application. Modified results (Mdfy) switches PP, PE ⇒ PO and ABS, PS, (SAN, PPO) ⇒ Styr and PBT, PET ⇒ PES and PCA ⇒ PC and APVC ⇒ PVC. Identification of PA , PO (PP, PE), Styr (ABS, PS), PES (PBT, PET), PC (PCA, PC), PMMA , PC , PVC and APVC .	
Sty4	S	This model is recommended to extend the identification of styrene-containing polymers up to four styrene types like: ABS, PS, SAN and PPO or to reduce it (just ABS and PS). The identification of filled PA, ABS, PVC and C-PVC with fillers (talcum, chalk, glass fibers) might become not reliable due to their NIR-spectra similarity. The extended Styrene identification can just be selected if the HaiPing model is activated before.	

⁶ IoSys uses the following abbreviations: PA=Polyamide, PO=Polyolefine, Styr=Styrene containing polymers, PES=Polyester, PCA=PC+ABS, PCPT=PC+PBT or PC+PET, APVC=ABS+PVC

⁷ Fine differentiation of PA6 and PA66 polymer types is not reliable. Therefore both types are calibrated and combined to PA6x.

4.4 Operating Elements in the Teach-In Menu

Sample icons (8) to teach-in (save) the spectra or to select

Increasing or decreasing the threshold value for the minimum Hit-Quality for the 1. Ranking in the hit list



Keyboard assignment

Increasing or decreasing the threshold value for the minimum Hit-Difference from the 1. to 2. ranking in the hit list

Touch Key Function

1..8 F1..F8 By pressing one of the eight sample icons the actual spectrum will be stored as a Teach-In sample. An gray coloured touch icon indicates that in respective slot no spectrum was stored before or it was deactivated (see **<Slct>**). The PLS mode must be activated to use the Teach-In spectra for polymer type identification (see: [Operating Elements in the Start-Display](#)).

Up 1 Increases the threshold value for the minimum Hit-Quality for the 1st ranking in the hit list⁸. If the 1st ranking percentage is less than the pre-set Hit-Quality value then the message **Low Hit-Quality** is shown.

Dwn 3 Decreases (Down) the threshold value for the minimum Hit-Quality for the 1st ranking in the hit list.

Slct 4 Switch to the Select bar for activation/ deactivation of respective Teach-In samples for the PLS-algorithm (dotted pattern style appears and the **<Slct>** icon changes to the **<Clr>** icon). Deactivated or not available storing places are shown in gray letters Pressing the **<Clr>** icon deletes all stored Teach-In samples (Clear) and renames the referring sample to numbers 1 to 8. Repeated touch of the **<Clr>** icon confirms the deletion process.

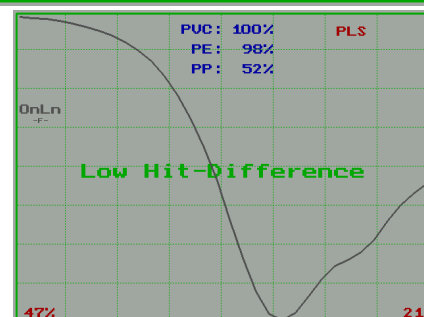
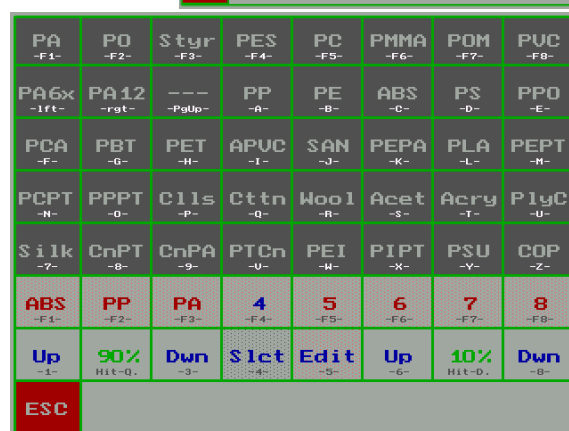
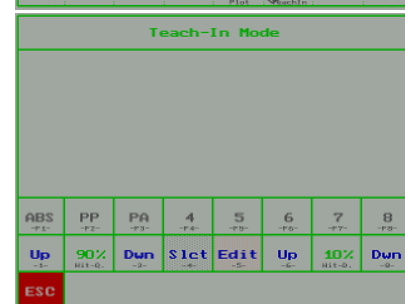
Edit 5 Switch to Edit-Menu for editing⁹ of the names of given plastic types⁹. The function is only active, if a sample icon has been selected before. Other names with max. 4 characters can be edited by opening the Teach-In File (see:

[The Teach-In File](#)).

Up 6 Increases the threshold value for the minimum Hit-Difference from the 1st to the 2nd ranking in the hit list. If percentage difference¹⁰ from the 1st to the 2nd ranking is less than the pre-set Hit-Difference then the message **Low Hit-Difference** is shown.

Dwn 8 Decreases (Down) the threshold value for the minimum Hit-Difference from the 1st to the 2nd ranking in the hit list.

ESC ESC Leaves the Teach-In menu and returns back to the Result display. All settings are automatically saved in the system file *Teach-XX.dat* which will be loaded when starting the system (see: [The System Files for siRoSlim](#)).



⁸ The Hit-Quality is the first threshold value, which the actual spectrum must exceed (degree of spectral curve similarity in % to the trained-in and stored Teach-In samples) to be indicated. For example: the NetD curve resembles to the Teach-in sample named PE to 91% and to the PP to 41%. If the pre-set Hit-Quality value for the 1st ranking is set higher than 91% (in this example) then the message **Low Hit Quality** is shown.

⁹ The upper menu bar for the given Textile/Carpet names is only shown if the system is equipped with a Textile/Carpet model (optional feature)

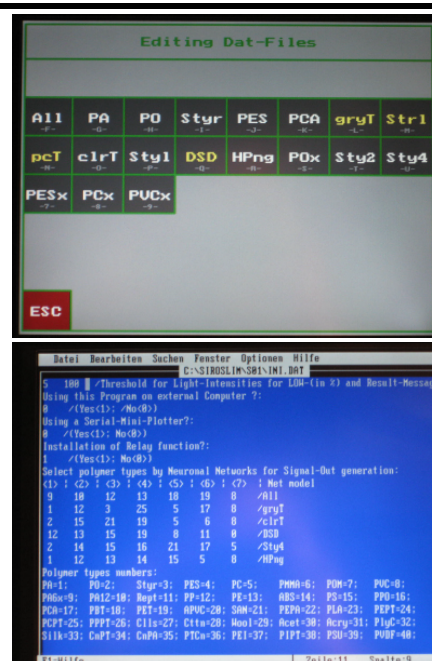
¹⁰ The Hit-Difference is the difference-threshold value, which must be exceeded (spectra difference of 1. to 2. ranking expressed as percentage ranges). For example: the NetD curve resembles to the Teach-in sample named PVC to 100 and to the PE to 98%. If the pre-set Hit-Difference value for the 1st to the 2nd ranking is set higher than 2% (in this example 100%-98% = 2% Hit-D) then the message **Low Hit Difference** is shown.

4.5 Operating Elements in the KEYS Mode

F1	F2	F3 PC-Link	F4	F5	F6 mlRoNet	F7 mlRoIni	F8 TeachIn
lft	rgt	SFT	A	B	C	D	E
F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U
7	8	9	U	W	X	Y	Z
4	5	6	+	-	.	,	\
1	2	3	TAB	/	*		up
ESC	0	OK	BS	F9	F10	ALT	dwn

Icon Key Function¹¹

PC-Link	F3	Starts the PC-Link program (intersvr.exe) to enables data exchanges for updates or copying files to another computer (see: Data Exchange).
mlRoNet	F6	Opens a further window with a menu bar to select neuronal network calibration files ¹² and system files. Pressing an icon/key starts the text editor with automatically loading the selected Dat- or Ini-Files. (see: The System Files for sIRoSlim).
mlRoIni	F7	Starts the text editor with automatically loading the initialization file (<i>ini.dat</i>) and selecting polymer types either to generate external signals (relay closer contact) for the FastMode function
TeachIn	F8	Starts the text editor with automatically loading the file <i>TeachIn-XX.dat</i> to edit sample names and pre-set threshold values (see: The Bottom Menu).
Test	T	Starts the Test program (sIRoXX16.exe) for testing electronic parts on the interface board of the sIRoslim device. In case of hardware operating malfunctions this diagnostic program helps to locate the error (see: The Bottom Menu).
QUIT	ESC	Leaves the Keys-Display and returns back to the Start-Display .



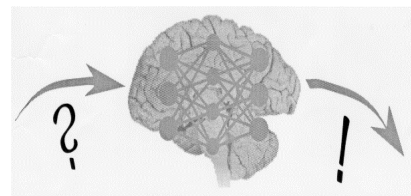
Do not make any changes to the formatting in the text files. Do not insert a decimal point with integer numbers.

¹¹ To operate the text editor an external keyboard should be connected. In general – if not otherwise noted - quitting the editor resets the loaded text file therefore modifications are directly taken over.

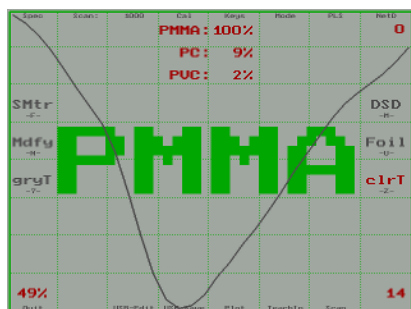
¹² The additional Dat-Files for the Textile model is only shown if the system is equipped with the optional Textile/Carpet feature.

4.6 Polymer Type Identification by Neuronal Networks

The identification of the polymer type using neuronal network is the result of a mathematical model for polymer identification. This data processing simply means a comparison with a pre-set pattern recognition¹³. Different types of plastics are categorized into a main group and into a number of sub-groups for fine differentiation.

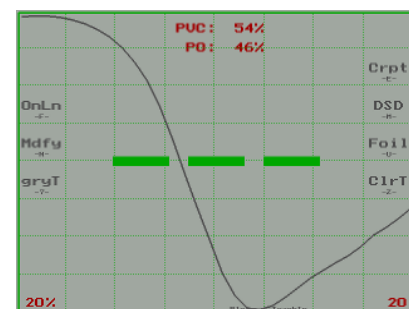


Due to this it is very important to select the right identification net model to obtain the correct identification result depending on colour (Standard or gray Types), thickness (Foils) or properties (clear Type) of the plastics to be measured.



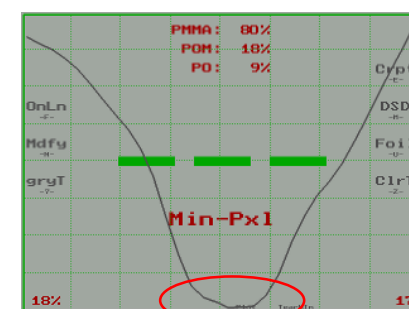
After the measurement, the near infrared intensity data (NirD) are mathematically transformed in ratio to the actual reference spectrum of the white ceramic plate and then normalized and scaled into network data (NetD). These values are processed with given weighting factors and special algorithms of the neuronal network model and stored. The pre-set data of the net model have been created, trained and stored by calibration beforehand. The result of the calculation is a ranking list of the most probable polymer types ranging between 0% and 100%. In the top of the Results window the three polymer types with the highest degrees of probability are displayed in red letters. The percentage value expressed the hit quality determined in the network model. It is not indicating the composition of a polymer blend! If the results of the measurement for a polymer type exceed the pre-set probability threshold values, then the plastic in the first place in the hit list is additionally displayed in large green letters in the middle of the display.

If the pre-set limit values have not been exceeded (e.g. 1st place less than 70 %, 2nd place greater than 30 %), it indicates that the neuronal network was not able to identify the sample reliably. Non-identification is signaled with the No-Result message (---). This is a request to repeat the sample measurement again. If repeated measurements still produce this message, the sample might be unknown (not calibrated) or the wrong net model was selected for identification or new recalibration is necessary.



4.6.1 The Min-Pxl statement

The pixel minimum of the NetD curve (Min-Pxl) is very characteristic¹⁴ for a polymer type and can alter depending on the thickness¹⁵ of the sample. In the file head of a Dat-file the specific Min-Pxl positions of plastics are listed as Minimum- and Maximum ranges. These values were determined during the calibration of the device for each polymer type. In case that the actual pixel minimum of the NetD curve (here: 17) is not in the range of the pre-set Min-/Max-Pixel value of a polymer identified (here: PMMA as the 1st hit list ranking of the identification probability) then the message **Min-Pxl** is shown (here: pre-set PMMA range 14-15). It indicates a logical restriction of the identification result due to the experiences made during the specific system calibration of the manufacture.



The pre-set Min-/Max-Pixel range for a polymer type should be adjusted¹⁶ (see:), if repeated measurements with known samples and correct identification probabilities for the 1st ranking still produce a No-Result message with the Min-Pxl statement.

File Edit Search View Options Help		
C:\mrsp\S23\ALL-23.DAT		
Min	MAX	Type
18	21	PA
17	22	PO
14	15	Styr
12	12	PES
13	14	PCA
14	15	PMMA
15	15	POM
18	20	PVC

¹³ The relative disadvantage of any neuronal network algorithm is that after the production no other polymer types can be calibrated by the user. The model is only valid for the given main and sub-groups. Modifications must be carried out on demand by the manufacturer.

¹⁴ Depending on the spectrometer system.

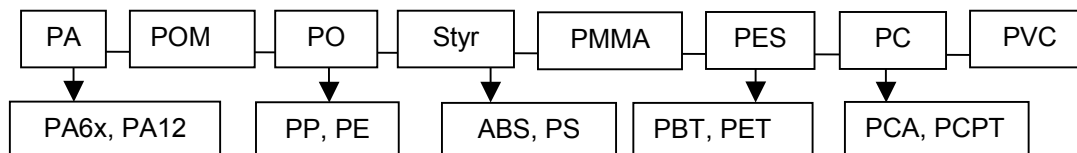
¹⁵ As an example: the Min-Pxl of a thin PE foil is usually at 22 whereby the Min-Pxl of solid PE sample ranges between 20-21.

¹⁶ Displacements of the predefined pixel positions in the spectrometer optics can occur as a result of temperature effects.

4.6.2 Standard Model (All, for coloured, natural or milky-like plastic parts):

This identification¹⁷ model is recommended when coloured, natural- or milky-like plastic parts (not gray, not black and not transparent) are to be detected. Herein the amount of polymer types for fine differentiation of the styrene-containing sub-group is reduced. Modified results (**Mdfy**) switches PA6x¹⁸, PA12 to PA and PP, PE to PO and ABS, PS to Styr and PBT, PET to PES and PCA, PCPT to PC. It means the identification will be simplified. The fine differentiation of the polymer type in the sub-group is modified/alterd to the main group.

Identification of **PA** (PA6x, PA12), **PO**¹⁹ (PP, PE), **Styr**²⁰ (ABS, PS), **PES** (PBT, PET), **PC** (PCA, PCPT)²¹, **PMMA**, **POM** and **PVC**:

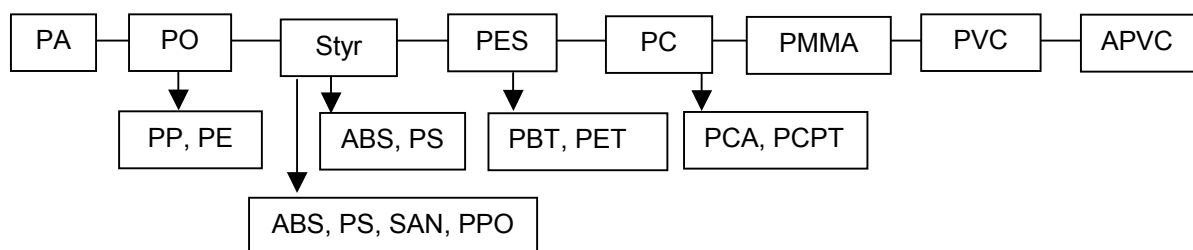


4.6.3 HaiPing Model with Sty4 function (HPng, for almost all plastics):

This identification model is recommended for almost all materials (thickness: 1 – 6 mm), except film/foils and dark coloured ones) for the conveyor belt application. The fine differentiation of the polycarbonate-containing sub-group for PCPT (PC+PET or PC+PBT) and for PA6x (PA6 and PA66) and PA12 is neglected.

With the activated extended Styrene model the identification of styrene-containing polymers up to four styrene types like: ABS, PS, SAN and PPO is extended²². Deactivation of Sty4 reduces the identification of styrene-containing polymers just to ABS and PS. The identification of filled PA, ABS, PVC and C-PVC with fillers (talcum, chalk, glass fibers) might become not reliable due to their NIR-spectra similarity. Modified results (**Mdfy**) switches PP, PE ⇒ PO and ABS, PS, (SAN, PPO) ⇒ Styr and PBT, PET ⇒ PES and PCA ⇒ PC and APVC ⇒ PVC.

Identification of **PA**, **PO** (PP, PE), **Styr** (ABS, PS, (SAN, PPO)), **PES** (PBT, PET), **PC** (PCA, PC), **PMMA**, **PC**, **PVC** and **APVC**:



¹⁷ IoSys uses the following abbreviations: PA=Polyamide, PO=Polyolefine, Styr=Styrene containing polymers, PES=Polyester, PCA=PC+ABS, PCPT=PC+PBT or PC+PET, APVC=ABS+PVC

¹⁸ Fine differentiation of PA6 and PA66 polymer types is not reliable. Therefore both types are calibrated and combined to PA6x.

¹⁹ To distinguish each Polyolefin group for the neuronal network calculation IoSys uses the following abbreviations:

PO for Standard (All) and POx for DSD and HaiPing-model.

²⁰ To distinguish each styrene-containing group for the neuronal network calculation and editing IoSys uses the following abbreviations: Styr for Standard (All), Sty1 for clear Type, Str1 for gray Type, Sty2 for HPng and Sty4 for HPng model with activated Sty4 model.

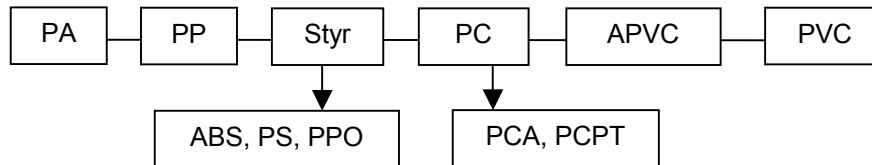
²¹ Due to their polymer similarity the identification of coloured PC, PCPT and PCA polymer types is sometimes uncertain. Blend ratios from PC/PBT or from PC/PET of 60:40, 50:50 and 40:60 are calibrated as "PCPT".

²² The extended Styrene identification can just be selected if the HaiPing model is activated before.

4.6.4 Gray Type Model (gryT, for gray-coloured plastic parts):

This identification model is recommended when gray-coloured plastic parts coming from the electro- and electronic disassembling area (e.g. computer waste) are to be detected. The restriction of the polymer identification to gray-coloured materials helps to work out the distinctive marks in the NIR spectra enhancing the NIR-identification performance for these materials. The amount of polymer types for fine differentiation of the polycarbonate-containing sub-group within this model is extended like PCPT (PC+PET or PC+PBT). Besides the identification of filled PA, ABS, PVC and C-PVC²³ with fillers might become better compare to the DSD and HPng-model.

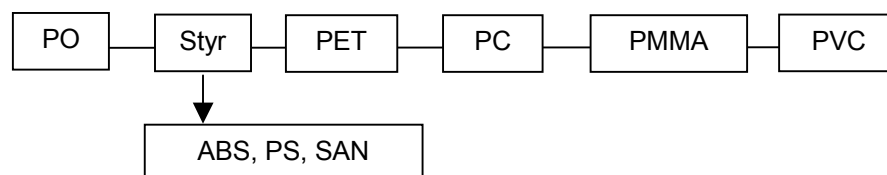
Identification of **PA**²⁴, **PP**, **Styr** (ABS, PS, PPO), **PCA** (PC, PCPT)²⁵, **APVC** and **PVC**:



4.6.5 Clear Type Model (clrT, for clear, transparent plastic parts):

Restriction of the polymer identification to few clear types which can normally occur also or only as clear, transparent plastic parts. This identification model is recommended (thickness: 1 – 6 mm), because the amount of polymer types for fine differentiation of the styrene-containing sub-group is extended and other types are neglected to enhance the identification performance. Materials which are thicker than 6 mm the result for clear materials might become not reliable even for materials which are thinner than 1 mm. Modified results (**Mdfy**) switches ABS, SAN (AS), PS to Styr.

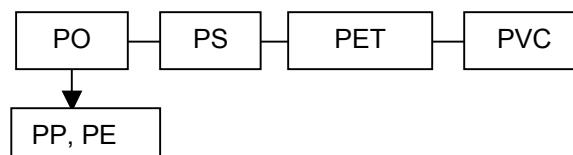
Identification of **PO**²⁶ (PE, PP), **Styr** (ABS²⁷, PS, SAN²⁸), **PET**, **PC**, **PMMA** and **PVC**:



4.6.6 DSD Model (for household and packaging plastics):

This identification model is recommended when typical plastic parts coming from the household and packing area (MWS) are to be detected, because the amount of polymer types is restricted to few polymer -types which normally occur as household and packaging plastics (MWS= DSD =Duales System Deutschland). To enhance the spectral variances, the database of ABS, PS are combined to PS and PBT, PET as PET. Modified results (**Mdfy**) switches PP, PE to PO.

Identification of **PO** (PP, PE), **PS**, **PET** and **PVC**:



²³ Chlorinate PVC which contains up to 73% chlorine.

²⁴ Fine differentiation of PA6, PA66 and PA12 polymer types is not reliable. Therefore all types are calibrated and combined to PA.

²⁵ Due to their polymer similarity the identification of gray coloured PC, PCPT and PCA polymer types is sometimes uncertain.

²⁶ No fine differentiation of transparent polyolefin is made in ClrT. Fine identification should be done via Standard (ALL) model. Nowadays transparent PO could be a polyethylene (COP) with copolymer like Surllyn® of DuPont™

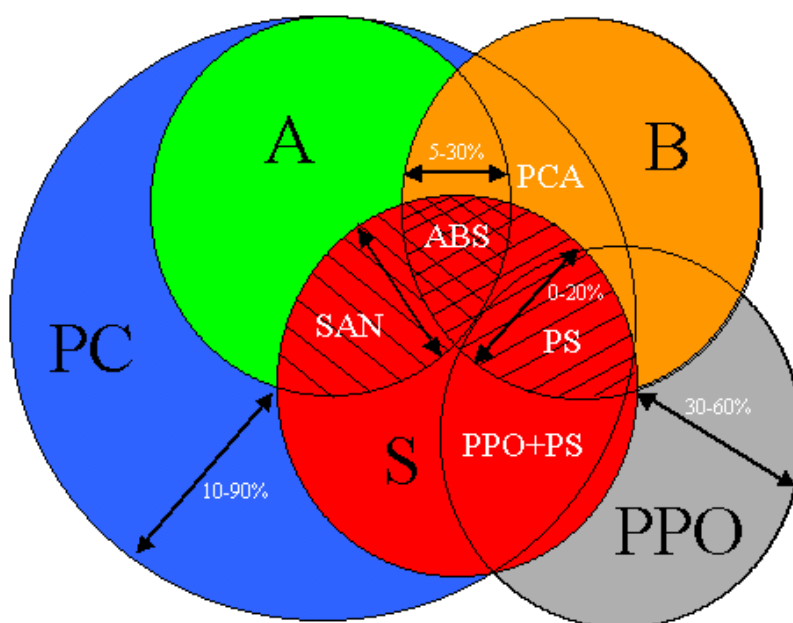
²⁷ Usually transparent ABS material is a blend which contains PMMA, too.

²⁸ SAN = Styrene-Acryl-Nitril is also named as AS = Acryl-styrene.

4.6.7 Composition of Styrene-containing Polymers

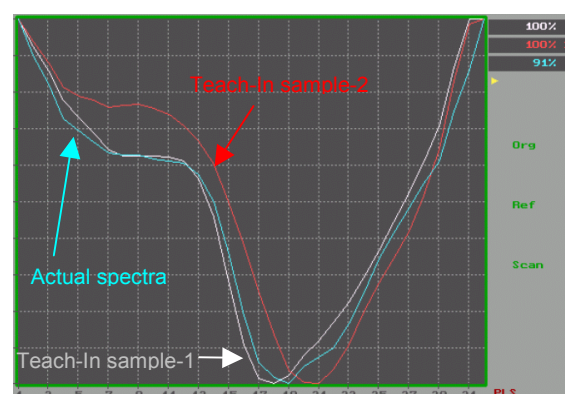
In general the differentiation of styrene-containing polymer types like ABS, PS, PPO, SAN (AS), PCA und APVC are difficult with the NIR Technology due to their polymer similarity. Most of them are blends of each other in different concentrations. But restriction of the polymer identification either to their colours (if coloured, natural- or milky-like (Standard) or if gray-coloured (gryT)) and to their material properties (if transparent (clrT) or thin (Foil)) or their characteristic fire retardant compositions helps to work out the distinctive marks enhancing the identification performance for these materials.

ABS: Acrylnitril-Butadien-Styrol, A: 5-30%, FR: Br (Cl)
 PS: Polystyrol ; HIPS = S/B; B: 0-20%, FR: Br, Cl
 PPO: Polyphenylenoxid+PS (S/B), PS: 30-60%, FR: P
 PCA: PC+ABS-Blend, PC/ABS: 10-90%, FR: P
 SAN (AS): Styrol-Acrylnitril (Acrylnitril-Styrol)



4.7 Polymer Type Identification by PLS

The identification of the polymer type using the PLS²⁹ method (Partial Least Square) is the result of a comparison of the measured spectrum with the stored Teach-in spectra (best fitting curve). It means that an actual spectrum (here: blue curve) is compared with all teach-in sample data which are activated (here: gray & red curves). The more the blue curve resembles to one of the Teach-in curves, the higher the Hit-Quality percentage. In this case the blue curve has the best fit to the gray one. As an example: the actual curve resembles to the blue curve to 91%.



²⁹ The advantage of the PLS method is that the user can teach-in own test samples to carry out simple rapid analysis. The disadvantage is that PLS works for NIR-spectra only which obviously have big spectral differences.

4.8 Recalibration of sIRoSlim

The background to the recalibration routine is that different known types of plastic have been calibrated against a reference standard (white ceramic plate). It means that the near infrared intensity data (NirD) of the known samples were mathematically transformed in ratio to this reference standard, normalized and autoscaled into network data (NetD) for modeling neuronal networks for plastic identification (see: [Polymer Type Identification by Neuronal Networks](#)). At that point of time the sIRoSlim system was calibrated (the so-called Design state³⁰), this reference spectrum was stored as the “original reference spectrum” (ORG).

Due to temperature effects, deviations in the sensitivity of the scanning electronics are shown up and therefore the resulting intensity data differ. In general, when the device is just powered on or if the system is used in a cold environment (cold state³¹) the NIR-signals of a measurement are less intense in comparison to the design state. Through the ratio method employed, the effect of changes to the state of the system are almost eliminated through the formation of intensity ratios (sample spectrum divided by the current reference spectrum). However, the identification capabilities of the spectrometer can be reduced in the cold state. A priori, the identification performance is best when the current signal output is similar to the design state.

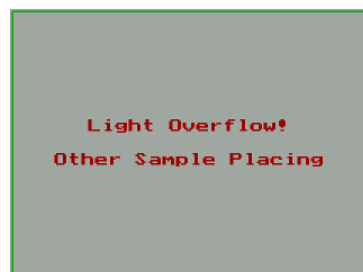
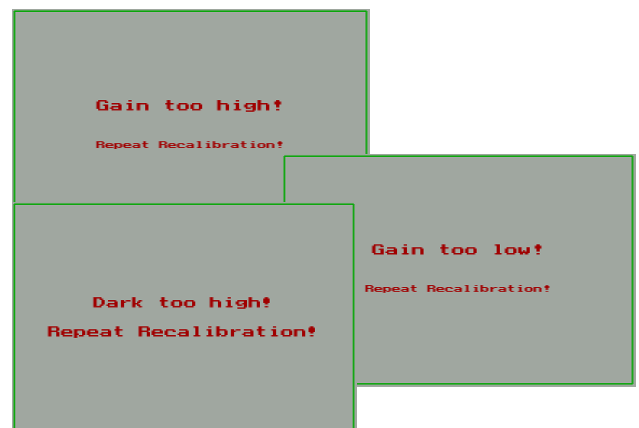


In order to operate the system immediately (no waiting time for warming up), a recalibration routine is programmed. The recalibration procedure for diffuse reflection and transmission measurements automatically adjusts the measurement electronics in a way that the current signal output of the reference standard closely fits to the stored original reference. Proceed as following to recalibrate the sIRoSlim part of the device:



At first after pressing the <F4> icon the sIRoSlim system starts the recalibration procedure with the message: **Remove any sample under the light**. No sample must be on the focusing spot. The next message: **Recalibrating...**, indicates that the automatic gain adjustment is finished. If the electronics is adjusted the NIR light source is powered down automatically for few seconds to carry out the dark measurement. The message: **Saved as new reference spectrum** signals the end of the recalibration procedure.

If an error message appears like the ones shown on the right side, repeat the recalibration.



Other error messages like **Light Overflow!** can be displayed during operation in case that a shiny sample has been placed in an unsuitable position for the NIR optics where the reflected light back to the NIR lens is higher than the white reference spectrum. In case that the intensity data of the actual reference measurement differs from the last signal curve, error messages like **Gain too high!** or **Gain too low!** are shown up. The recalibration procedure has to be repeated.

If more than 10 times a **Light Overflow** signal is measured (shown by a counter on the right top side of the screen) then the message **Starting autom. Recalibration** is displayed. It indicates the beginning of the automatic gain adjustment.

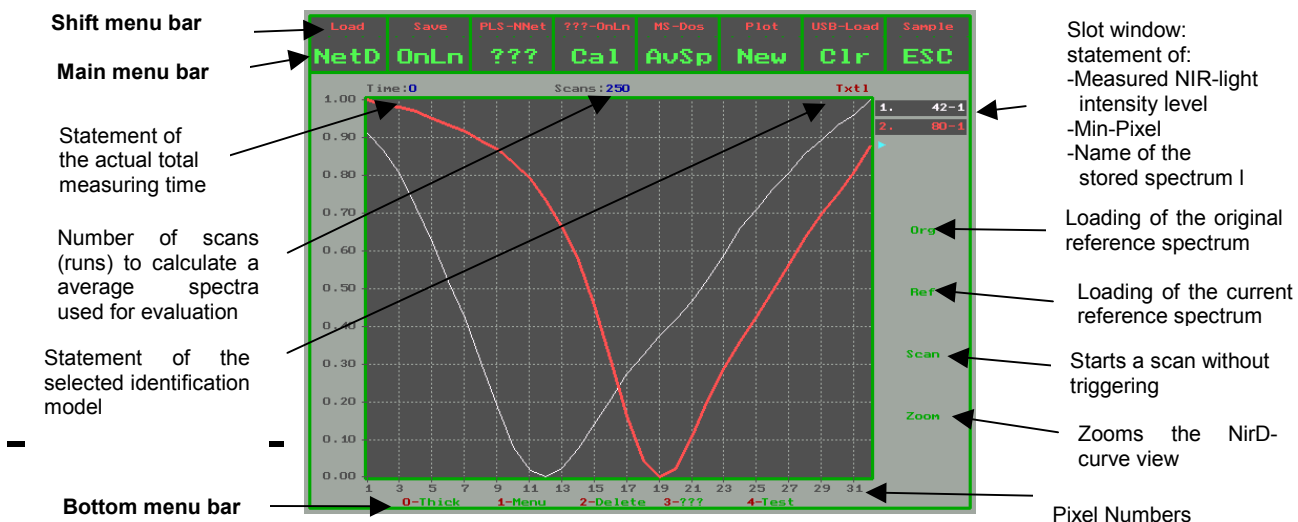


³⁰ Design state: For sIRoSlim calibration the system was always powered on 2 hours before at a room temperature of 22 °C to ensure that the device was in a thermal equilibrium and thus the resulting signals were stable and reproducible.

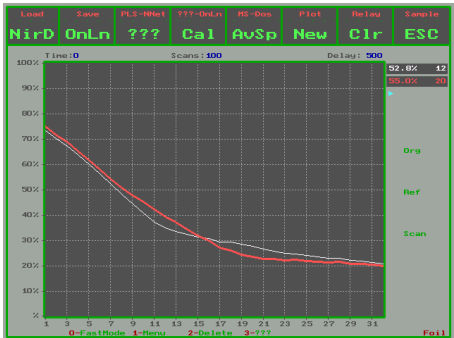
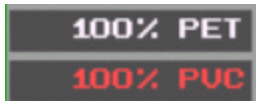
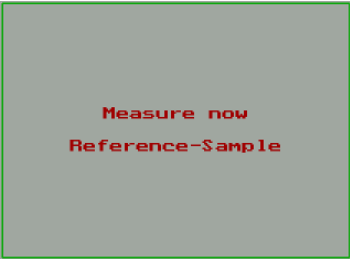
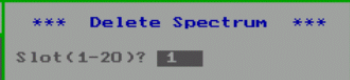
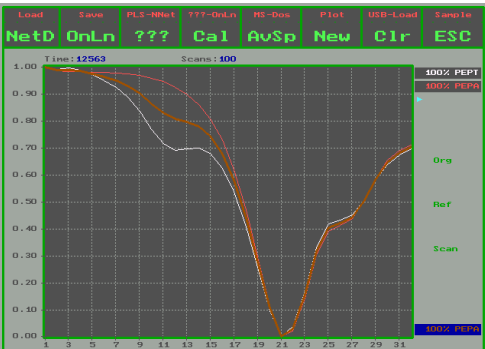
³¹ Cold state: When the sIRoSlim is just powered on, it is not in a thermal equilibrium. At the beginning the spectra are lower in intensity, drifting towards higher values within 2 hours, i.e. the signal outputs are unstable and non-reproducible.

4.9 Operating Elements in the SPC Mode

4.9.1 The Main Menu




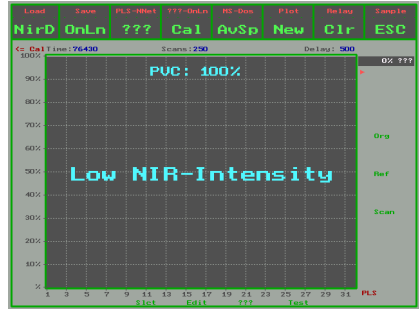

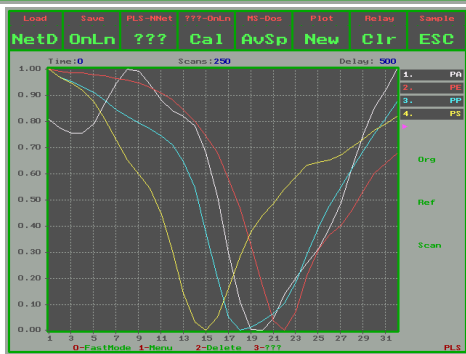
Display	Key	Function
---------	-----	----------

NirD	F1	Switches between the representation views. In the <NirD> mode the raw intensity data are shown and in the slot window the measured NIR-light intensity level and Pixel number of the curve minimum is listed (Min-Pxl). In the <NetD> mode mathematically transformed intensity data are displayed. In the slot window the slot number and the sample file name is listed if stored before.	
OnLn	F2	Starts the Online mode wherein the spectrometer optic is continuously read out without triggering. The online spectrum is displayed in slot place#1. The Online mode allows to display simultaneously other spectra or permits e.g. external light sources held in front of the measuring head to be adjusted for the transmission mode (optional feature). Pressing again the <OnLn> Display stops the online measurement.	
???	F3	Activates the polymer type identification (PLS or neuronal network) for all displayed spectra. In the NetD-mode the identification result and the 1 st ranking percentage for each spectrum is listed in the corresponding slot window. Pressing again the <??? Display returns back to the statements of NIR-light intensity and Min-Pxl or sample file name.	
Cal	F4	Starts the recalibration routine with auto-gain-adjustment (see: Recalibration of sIRoSlim). In the NirD mode the original reference spectrum is automatically loaded in slot place#2 for better comparison and the actual raw intensity data are displayed in slot place#1. If the <Cal> function is unintentionally pressed the recalibration routine can be stopped pressing the <Clr> key.	
AvSp	F5	Forms an average spectrum (not auto scaled) from all the spectra which are displayed and plots it in slot place#20 as a brown dotted line (or as a thick brown line if <t> press) with a blue colored slot window. Pressing the key again cancels arithmetic forming of an average mean.	
New	F6	Opens the New-window to delete the representation of a spectrum at a slot place. The next spectrum now appears at the slot place marked with „►“.	
Clr	F7	Deletes all the spectra represented at the slot places.	
ESC	F8	Leaves the program and returns back to the DOS prompt level.	

4.9.2 The Shift Menu

Load	Save	PLS-NNet	???-OnLn	MS-Dos	Plot	USB-Load	Sample
NetD	OnLn	???	Cal	AvSp	New	Clr	ESC

Display	Key	Function
---------	-----	----------

Load	Sft+F1	Opens the Load-Spectrum window to open spectra which were saved in the directory path edited under Dir (max. 22 letters). A temporary change to the pre-set directory (edited in the Initialization File) and path can be carried out under Dir. The files are listed in filtered form in accordance with the characters ³² entered. Moving within the window can be done with the Enter or Cursor up/down key. Loaded spectra are shown in different colors after quitting the menu.	
Save	Sft+F2	Opens the Save-Spectrum window to permit spectra to be stored in the directory path edited under Dir (max. 22 letters). A saved spectrum file gets the file suffix „.spc“ and are written in a Flat ASCII text format.	
PLS-NNet	F3	Switches between the PLS model (Partial-Least-Square) or the <u>N</u> euronal <u>N</u> etwork calculation. To actualize the identification results for all displayed spectra after changing the algorithm the <???> key must be pressed again.	
???-OnLn	Sft+F4	Starts/stops the Result-Online identification mode which continuously displays the identification result with the hit list ranking (automatically activated for sIRoSlim). The hit list and the result is displayed in green letters or in red (for modified results) for neuronal network identification. The hit list and the result is displayed in blue letters for the PLS mode. Pressing the <OnLn> or <Clr> Display stops the online identification measurement.	
MS-Dos	Sft+F4	Opens the MS-Dos menu for carrying out given MS-Dos operation commands:	
Plot	Sft+F6	Prints ³³ out the actual display as a screen dump to a Mini-Plotter (optional feature). Pressing any key on the Keyboard stops the plotting process.	
USB-Load	Sft+F7	Opens the USB-Load Menu to load spectra which were saved in an external USB-stick ³⁴ in the pre-set subdirectory (e.g. in d:\nir\). Operating elements are the same as described under Load .	
Sample	Sft+F8	Loads all activated Teach-in samples (max. 8 spectra with the edited file names in the slot #1 up to slot #8. This function allows to give an overview of the stored Teach-In sample data set.	
./.	Sft+F9	Starts the recalibration routine <u>without</u> auto-gain-adjustment (not displayed in the Shift menu bar). This procedure is recommended if own application (analysis method) is created.	

³² A backslash (\) edited at first of the file name activates the loading/saving of a file series. For example, the entry \kal-0 loads/saves all spectra beginning with the file from kal-1; an entry \kal-1 loads/saves all spectra beginning from kal-11.

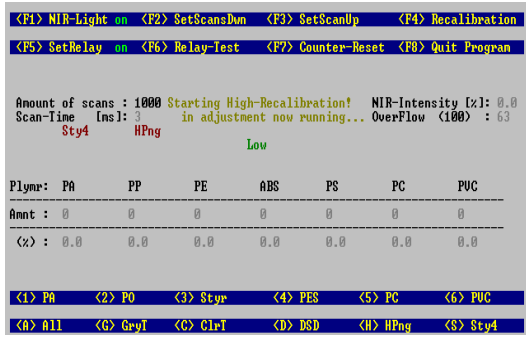
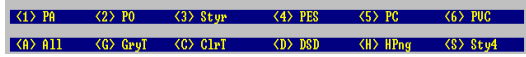
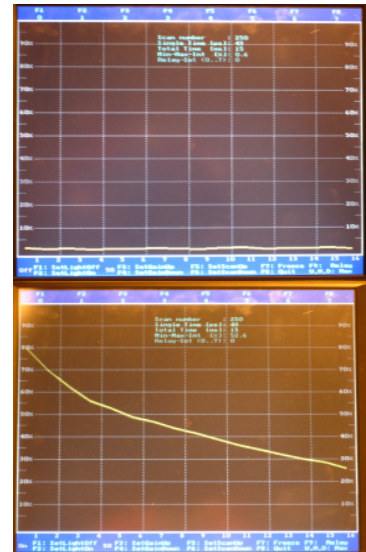
³³ Only active if a the Mini-Plotter is connected and the hardware is activated in the initialization file Ini.dat.

³⁴ The stored NIR-spectra at the USB-Stick have a different file format (in rows/lines), thus these files can not be read and load with the Load-Function (F1).

4.9.3 The Bottom Menu

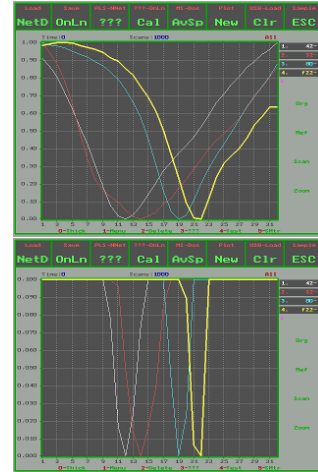
0-FastMode 1-Menu 2-Delete 3-??? 4-Test

Display Key Function

FastMode 0	Start the Fastmode subprogram in the text mode (no graphics) for the fastest Online identification with percentage statements. In this Mode (online.exe) up to 7 preset polymer types (see: The Initialization File) can be counted ³⁵ with corresponding external signal generation. If a value exceeds 99.999.999 or by selecting another identification model the counter is reset. Operation hotkeys are almost the same as described for the Online-Mode.	
Menu 1	Opens the menu bar (also with <ENTER>) to select either a net model for polymer type identification (<F1>..<F6>) and/or to open the another window to select and to edit Dat- and Ini-files of the system. A text editor opens with automatically loading the file chosen for editing.	
Delete 2	Deletes the last displayed spectrum (also with <Backspace>) with the highest slot number.	
??? 3	Switches to the Result-window for 2 sec. Always an average spectrum is evaluated. It means, if several spectra are shown then a corresponding mean of all displayed spectra is calculated and this result is displayed for a short time.	
Test 4	Starts the Test program for testing electronic parts on the NIR-interface board of the device part. In case of hardware operating malfunctions this diagnostic program helps to locate the error. For example: the NIR-lights are switched on and off by using <F1> or <F2> . The relay functions for the external signal generation are tested by <F9> . By pressing <1>..<7> each single relay can be checked whereby <0> powers up all relays. The gain adjustment function of the electronics are checked by using <F3> or <F4> or with the means of the Hotkeys <d> (gain down), <m> (gain mid) and <u> (gain up). The amount of scans (preset 250) can be altered using <F5> or <F6>.	

4.9.4 Additional Operating Elements

Icon Key Function

Scans <=>	Decreases (<=>) or increases (=>) the number of runs ³⁶ (scan numbers) to form an average mean spectra for evaluation in steps of 1, 10, 50, 100, 250, 500, 1000, 2000, 3000, 4000 and 5000. The scan numbers can be changed by pressing the Cursor left or right key repeatedly. The default value is <u>1000 scans</u> , a priori, to obtain a stable average spectrum for evaluation	
Org O	Loads the <u>original</u> -reference spectrum into the next vacant slot.	
Ref R	Loads the current <u>reference</u> spectrum into the next vacant slot.	
Scan #	Starts a scan without pressing the trigger (also with <Space>). The spectrum appears at the slot place marked with „ # “ before.	
Zoom ↑	Zooms the representation view of the displayed data curves. In the <NetD> mode the intensity percentage ranges then from 0-0.1% which makes it easier to see peak minima (e.g. to detect abnormal curve shapes). In the <NirD> mode the spectra is auto scaled between the first and last Pixel value. Pressing the <Cursor-up> icon again returns back to the full image representation	
./. P	Activates the polymer type identification (PLS or neuronal network) for all displayed spectra (same as <????> icon).	

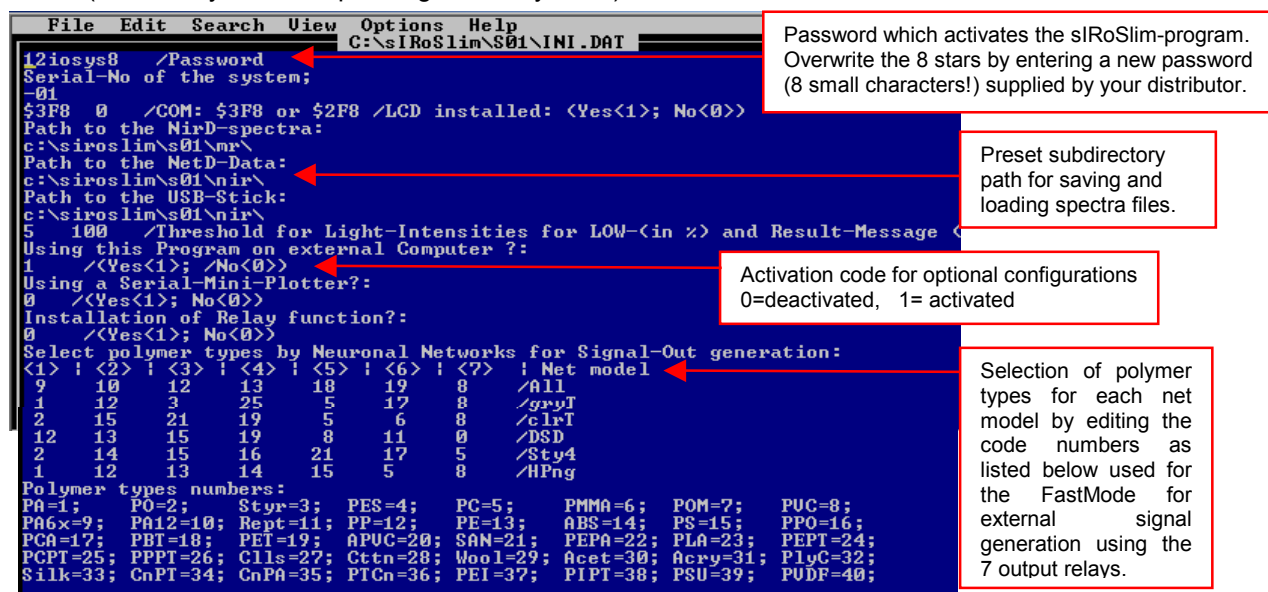
³⁵ Due to the very fast online measurements in the FastMode the identification result is only shown and counted and the external signal by relay is only generated if the identification result is two times the same successively.

³⁶ The higher the scan number (RUNS), the better the resulting average spectra (improved signal/noise ratio of the calculated mean), the more stable is the identification result. However, the measuring time takes longer. On the other hand, the smaller the scan number, the more noisy the resulting spectra for evaluation, the less stable is the identification result. On the other hand the measuring time takes shorter.

5 The System Files for sIRoSlim

5.1 The Initialization File

Pre-set parameters like the serial number of the unit, hardware address, directory paths and the activation of optional features are stored in the file: *ini.dat*. This text file can be opened by pressing the **<F7>** (mIRoIni) in the **Keys-Display** (see: [Operating Elements in the KEYS Mode](#)). As an example a typical initialization file is listed: (data always differ depending on the system!).



The screenshot shows the sIRoSlim initialization file (ini.dat) with the following content:

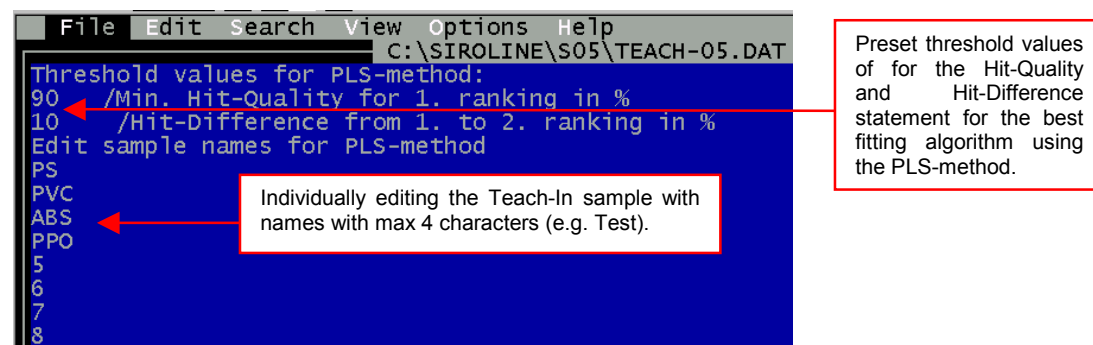
```
File Edit Search View Options Help
C:\sIRoSlim\S01\INI.DAT
12iosys8 /Password
Serial-No of the system;
-01
$3F8 0 /COM: $3F8 or $2F8 /LCD installed: <Yes<1>; No<0>>
Path to the NirD-spectra:
c:\siroslim\s01\mr\
Path to the NetD-Data:
c:\siroslim\s01\nir\
Path to the USB-Stick:
c:\siroslim\s01\nir\
5 100 /Threshold for Light-Intensities for LOW-(in %) and Result-Message
Using this Program on external Computer ??
1 /Yes<1>; No<0>>
Using a Serial-Mini-Plotter?:
0 /Yes<1>; No<0>>
Installation of Relay function?:
0 /Yes<1>; No<0>>
Select polymer types by Neuronal Networks for Signal-Out generation:
<1> ! <2> ! <3> ! <4> ! <5> ! <6> ! <7> ! Net model
9 10 12 13 18 19 8 /All
1 12 3 25 5 17 8 /grryT
2 15 21 19 5 6 8 /clrT
12 13 15 19 8 11 0 /DSD
2 14 15 16 21 17 5 /Sty4
1 12 13 14 15 5 8 /HPng
Polymer types numbers:
PA=1; PO=2; Styr=3; PES=4; PC=5; PMMA=6; POM=7; PUC=8;
PA6x=9; PA12=10; Rept=11; PP=12; PE=13; ABS=14; PS=15; PPO=16;
PCA=17; PBT=18; PET=19; APUC=20; SAN=21; PEPA=22; PLA=23; PEPT=24;
PCPT=25; PPPT=26; C11s=27; C12n=28; Wool=29; Acet=30; Acry=31; PlgC=32;
Silk=33; CnPT=34; CnPA=35; PTCn=36; PEI=37; PIPT=38; PSU=39; PUDF=40;
```

Annotations:

- Password which activates the sIRoSlim-program.** Overwrite the 8 stars by entering a new password (8 small characters!) supplied by your distributor.
- Preset subdirectory path for saving and loading spectra files.**
- Activation code for optional configurations** 0=deactivated, 1= activated
- Selection of polymer types for each net model** by editing the code numbers as listed below used for the FastMode for external signal generation using the 7 output relays.

5.2 The Teach-In File

Sample names and pre-set threshold values edited in the Teach-In menu are stored in the file: *teach-XX.dat* (XX=series number). This text file can be opened as describe before and pressing the **<F8>** key. As an example a typical Teach-In file is listed:



The screenshot shows the sIRoSlim Teach-In file (teach-05.dat) with the following content:

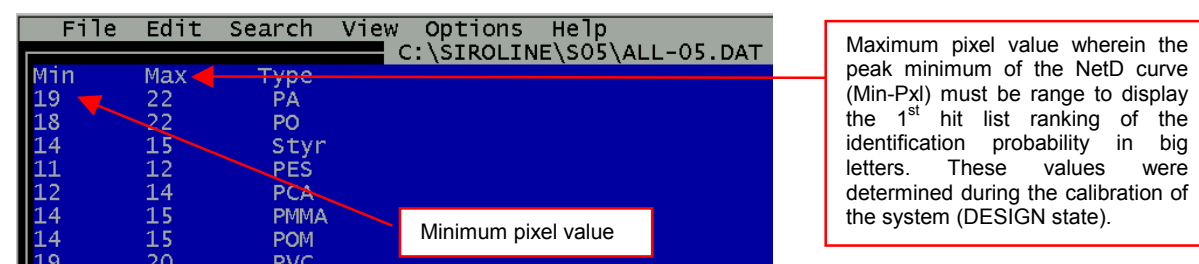
```
File Edit Search View Options Help
C:\SIROLINE\S05\TEACH-05.DAT
Threshold values for PLS-method:
90 /Min. Hit-Quality for 1. ranking in %
10 /Hit-Difference from 1. to 2. ranking in %
Edit sample names for PLS-method
PS
PVC
ABS
PPO
5
6
7
8
```

Annotations:

- Preset threshold values of for the Hit-Quality and Hit-Difference statement for the best fitting algorithm using the PLS-method.**
- Individually editing the Teach-In sample with names with max 4 characters (e.g. Test).**

5.3 The Dat-Files

The Min-/Max-Pixel range of the NetD curve minimum and given values of the neuronal network models (weighting factors) are stored in the Dat-files *modelname-XX.dat* (XX=series number). These text files can be opened as described before in the **Keys-Display** by switching into the **mIRoNet Menu** with **<F6>** and then pressing the **<f>..<u>..<9>** keys or model name icons.



The screenshot shows the sIRoSlim Dat-File (modelname-05.dat) with the following content:

```
File Edit Search View Options Help
C:\SIROLINE\S05\ALL-05.DAT
Min Max Type
19 22 PA
18 22 PO
14 15 Styr
11 12 PES
12 14 PCA
14 15 PMMA
14 15 POM
19 20 PVC
```

Annotations:

- Maximum pixel value wherein the peak minimum of the NetD curve (Min-Pxl) must be range to display the 1st hit list ranking of the identification probability in big letters.** These values were determined during the calibration of the system (DESIGN state).
- Minimum pixel value**